SWRHL-4r

FINAL REPORT OF OFF-SITE SURVEILLANCE FOR OPERATION STORAX

by the
Southwestern Radiological Health Laboratory
U. S. Public Health Service
Department of Health, Education, and Welfare
Las Vegas, Nevada

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July 20, 1965

This surveillance performed under a Memorandum of Understanding (No. SF 54 373)
for the
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ABSTRACT

This report describes the methods used and the results obtained from off-site surveillance conducted during Operation Storax; July 1, 1962 to June 30, 1963, by the Southwestern Radiological Health Laboratory, Las Vegas, Nevada for the Atomic Energy Commission (AEC). Analysis of the results obtained from various environmental sampling programs indicates that the safety criteria established by the AEC for the off-site population were not exceeded as a result of any one or combination of events of Operation Storax.

FOREWORD

This report covers the activities of the U. S. Public Health Service's Southwestern Radiological Health Laboratory. These activities are conducted in accordance with a Memorandum of Understanding with the Atomic Energy Commission. In part, this memorandum authorizes the U.S. Public Health Service to investigate, assess, record, and report the radiological situation in the public areas surrounding the Nevada Test Site, and to inform and protect the public should an unacceptable radiological situation develop.

This report is to be considered the final report for Operation Storax and supersedes all previous reports issued by the Public Health Service for this series. All future requests for data on Operation Storax will be referenced to this report. It is neither possible nor desirable to include in this report every item of data obtained. However, summaries of all data pertaining to exposures or contamination of people or of property in the off-site areas have been included.

Every effort has been made to eliminate errors in the report. If any errors are detected, typographical or otherwise, it will be appreciated if they are brought to the attention of the Off-Site Surveillance Section so that they may be checked against original records.

During the period covered by the Storax series, four atmospheric events under Operation Dominic II, and one Plowshare event (Project Sedan) were conducted at the Nevada Test Site. Four alpha scattering events under Project Roller Coaster were conducted north of the Nevada Test Site, on the Nellis Air Force Range. Separate SWRHL reports contain the data for these projects.

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Chapter 1
INTRODUCTION

Operation Storax was a series of underground nuclear tests conducted by the U. S. Atomic Energy Commission (AEC) at their Nevada Test Site, northwest of Las Vegas, Nevada. As for past operations, the U. S. Public Health Service (PHS) carried out a program of radiological surveillance of the public areas off site for the Operational Safety Division of the AEC's Nevada Operations Office. This surveillance is conducted under a Memorandum of Understanding between the U. S. Atomic Energy Commission and the U. S. Public Health Service.

The Off-Site Radiological Safety Program of the Southwestern Radiological Health Laboratory (SWRHL) conducts its present program of radiological monitoring and environmental sampling in the off-site areas surrounding the restricted area enclosed within the Nevada Test Site and the Nellis Air Force Range. This overall complex of the Nevada Test Site (NTS) and the Nellis Air Force Range (NAFR) includes the Nuclear Rocket Development Station (NRDS) and the Tonopah Test Range (TTR) and for simplicity will be called the test range complex throughout this report.

In order to carry out the assigned program of off-site surveillance, the PHS organized, equipped, and trained aerial monitoring teams, mobile ground monitors, and provided for periodic sampling of air, milk, water and vegetation. A system of permanent, continuous air sampling stations was established at locations surrounding the test range complex, and provisions were made to supplement these stations with temporary samplers if the need arose. During the latter part of the Storax series, additional sampling points were established for regularly scheduled milk

and water sample collection to augment the routine and special "shot" samples that were being collected.

A. VETERINARY SERVICES

An Army Veterinarian assigned to the AEC-NVOO was available to the Public Health Service during the operation. Liaison was maintained with livestock producers in the area and the animal investigation program of wildlife and cattle was continued. Semi-annual slaughter of cattle from the NTS herd and the Knoll Creek and Delamar Valley herds was accomplished in cooperation with the University of Nevada. Specimens from these animals were analyzed for radionuclides.

B. PUBLIC RELATIONS

An important part of off-site radiological safety activities is that of public relations. In their everyday contacts with residents of the off-site area, PHS personnel express their desire to speak to local groups to explain the programs at the Nevada Test Site and the role of the Public Health Service in them.

Talks and films covering elementary atomic physics and radiation effects are given to school groups, while civic groups are offered talks and films on atomic testing and the safeguards exercised to protect the public.

A number of off-site residents took part in the environmental sampling program. All routine sampling stations except Las Vegas were operated by local citizens and many more people wore film badge dosimeters. This cooperation saved greatly on manpower requirements, and gave the individuals in a community a feeling of participation in the PHS activities.

Chapter 2

METHODOLOGY

A. SAFETY CRITERIA

The criteria by which the off-site radiological situation was to be judged were established by the Atomic Energy Commission.

> "For planning weapons tests, the criterion shall be 3.9 roentgens per year whole body exposure, including any exposure from non-weapons test activities (but excluding background and medical X-rays). The criterion of 3.9 roentgens is in the definite context used in the past; i.e., every reasonable effort should be made to keep the radiation exposures as low as possible, but for planning purposes, if unanticipated yet credible circumstances could result in estimated doses in excess of 3.9 roentgens per year, then the detonations should be postponed until more favorable conditions prevail. Also, to avoid any given community receiving unusually high exposures over a period of years, the guide shall be not more than 10 roentgens in any consecutive 10-year period."

> "The Guides for radioactivity in air, water, milk and foodstuffs were not to exceed one-tenth the values listed in AEC Manual Chapter 0524, Standards for Radiation Protection, dated August 12, 1963. These concentrations may be averaged over twelve consecutive months."

B. OPERATIONAL PROCEDURES

1. Ground Monitoring

During all the events of this series the Off-Site Radiological Safety Officer, or his designated representative, was present at the Control Point to direct the activities of the Off-Site Surveillance Section. Normally, this included one or more aerial monitoring teams, from six to ten mobile monitors, and the facilities of the Southwestern Radiological Health Laboratory for sample processing and data reduction.

Several hours before a scheduled event the ground monitors were deployed in the off-site areas most likely to be affected by a possible release of radioactive material. These monitors were in radio communication with the Control Point and carried monitoring supplies and equipment required to accomplish their mission. In the event a release of radioactive material was detected by the aerial monitoring team, mobile ground monitors were directed from the Control Point to downwind areas. Measurements with portable instruments were taken and were radioed to the Control Point. If the nature or intensity of radioactive contamination was sufficient to require further surveillance, ground monitoring was performed on the days following the event. Measurements for both gamma and beta plus gamma were taken at ground level and three feet above ground level. The pattern of residual activity was documented in this manner.

Air, water, milk, and vegetation samples were collected as directed by the Radiological Safety Officer and brought to the laboratory for analysis.

2. Aerial Monitoring

Approximately thirty minutes before a scheduled event, an aerial monitoring team was airborne within visual distance of Ground Zero. After detonation, low level passes were made over the surface at Ground Zero. If no activity was detected, and if this was confirmed by ground station radiation monitoring telemetry instruments, the mission was terminated by the Radiological Safety Officer. If activity was detected, the aerial monitoring team flew a series of passes at various altitudes to establish relative radiation intensities and the direction of

the airborne effluent. Cloud tracking continued until levels of activity decreased below the detection limits of the instruments used, or until flying conditions forced cessation of the mission.

C. EXTERNAL MEASUREMENTS

1. Ground and Aerial Monitors

Each ground monitor was equipped with the following monitoring instruments: an Eberline E-500B, a Precision Model 111 Standard "Scintillator", a Beckman MX-5, and a Tracerlab AN/PDR T1B. The Eberline E-500B has a range of 0 to 200 milliroentgens per hour (mr/hr) gamma and beta-gamma detection in four scales with an external halogen filled G.M. tube and a 0 to 2000 mr/hr range from an internal Anton 302 tube. The Precision Model 111 "Scintillator" is used primarily for low level detection and provides for a range of 0 to 5 mr/hr in six scales. The Beckman MX-5 instrument has a range of 0 to 20 mr/hr in three scales. It is equipped with an external Geiger tube with a slide-open beta shield. The Tracerlab T1B has a range of 0 to 50,000 mr/hr in five scales. This instrument employs an air ionization chamber detector. These instruments are accurate to $\pm$20%, and readings are taken to two significant figures.

Aerial monitoring teams used the same four instruments described above, with the addition of a Model SBL-2 Aerial Survey Instrument. This device, manufactured by the Edgerton, Germeshausen, and Grier Company, is a battery operated portable scintillation detector and recorder with a detection range of 2 to 2000 mr/hr. The Model SBL-2 can be used to measure incident dose rate at the instrument, or to record fallout gamma activity levels at one meter above the ground

by flying at a constant altitude of 100, 300, or 500 feet above ground level.

2. Dose Rate Recorders and Film Badges

During the early part of the Storax series (July and August), dose rate recorders were used at several locations. This instrument operated on 12VDC or 110VAC and had a range of 0.01 to 100 mr/hr. These instruments proved unsatisfactory under field conditions and were returned to the company for modification.

The PHS maintained approximately sixty-five film badge stations and there were from 100 to 200 film badged individuals in the off-site areas. The badges used were DuPont type 556, Component Films 508 and 834. Under ideal conditions, these badges have an accuracy of $\pm$25% on the lower range (30 mr to 5R) film and $\pm$10% on the higher range (5R to 10R) film. Accuracy under field conditions can decrease to $\pm$50% for the lower range.

D. ENVIRONMENTAL MEASUREMENTS

1. Air Samples

Air samples were collected with high volume, turbine type air samplers. All air samplers used by the PHS during this operation were manufactured by the General Metal Works Company and the Staplex Company. Although construction details differ, both machines operate in the same manner.

The motor unit connects to a stainless steel filter holder which holds the prefilter, and the throat of the motor accommodates a 3-1/4" diameter activated charcoal cartridge for the collection of certain gaseous fission products. The prefilter is an

8"x 10" Gelman type "E" glass fiber filter with a collection efficiency of 99.6% for particles larger than 0.25 microns and greater than 98% for particles as small as 0.05 microns.

Normal air flow through the unit is 45 - 60 cfm with the glass fiber filter in place, and 20 - 30 cfm with the addition of the charcoal cartridge filter to the system. Air flow is measured with a rotameter inserted in the back of the unit. After collection, prefilters were returned to Las Vegas for gross beta counting with a thin window, large area proportional probe connected to a high speed scaler. All charcoal cartridges and any prefilters showing high gross beta activity were analyzed for specific gamma emitting isotopes with a RIDL 400 channel gamma spectrometer or a TMC Model 402, 400 channel spectrometer.

2. Other Environmental Sampling

Milk and water samples were collected at monthly intervals after August 31, 1962. Prior to that time only random and "shot" samples were collected. In addition to the regularly scheduled milk and water sampling, special "shot" samples were collected after a real or suspected release of effluent into the off-site areas.

All milk samples were analyzed for specific gamma emitting isotopes, then chemically separated and counted for strontium-89 and -90. Water samples were evaporated to dryness and then counted for gross beta activity in the same manner as the air filters. In certain instances the water samples were analyzed for isotopic content and for the presence of alpha emitters.

3. Analytical Procedures and Statistics

a. Gross Beta

Air filters were counted with thin window proportional counters connected to high speed scalers designed to minimize coincidence losses. Efficiency of the system is 35% for 1.5 Mev betas.

All air samples are counted for gross beta activity upon receipt at the laboratory, and again at five and twelve days later. The latter two counts are used to extrapolate to end of collection period by applying a $T^{-1.2}$ correction factor.

The minimum detectable level is about 100 picocuries total activity on the filter. For the average air sample of approximately 1000 M^3, this corresponds to a minimum concentration of 0.1 pc/M^3 with an associated error of $\pm$100 pc total, or 10% whichever is larger.

Due to the presence of natural radon and thoron daughter product activity on the filter immediately after collection, the minimum level of fresh fission products detectable within the first 12 hours after collection is about 5 to 10 pc/M^3 for a 1000 M^3 sample.

b. Isotopic

Where indicated by a high gross beta count, the glass fiber filters are gamma scanned by folding into a package 2"x 2-1/2" and placing directly on top of a 4"x 4" NaI crystal assembly coupled to a multichannel analyzer (400 channels) set to examine the energy range 0 to 2.0 Mev. The detection efficiency of this method is about 12% for the 0.364 Mev photopeak of I^{131}. Resolution of the system is about 8%.

The minimum detectable level for fresh fission products is approximately 400 pc total for I^{133}, I^{135}, I^{132}, and Te^{132} with an error of ± a factor of two.

The longer lived isotopes can be quantitated at approximately 100 pc with an error of ±25%, after the decay of the shorter lived isotopes. On an early scan, however, these longer lived fission products (I^{131}, $Ru^{103-106}$, Zr^{95}-Nb^{95}, Ba^{140}-La^{140}), in the presence of the above short lived isotopes, are subjected to the higher detection limit (400 pc) and errors.

c. Charcoal Cartridges

The same limitations which apply to prefilters also apply to charcoal cartridges. In the presence of I^{132} and I^{135}, the minimum detectable level is 400 pc total ± a factor of two. With I^{133} and I^{131} alone on a cartridge this is reduced to 100 pc total ± 10%.

d. Milk

Iodine-131, cesium-137 and barium-140 concentrations are determined by gamma scintillation spectroscopy. After gamma scanning, samples are chemically separated and counted for Sr^{89} and Sr^{90}. Calcium analyses are performed by the ethylenediaminetetraacetic (EDTA) method. Stable potassium concentrations are determined from the potassium-40 concentrations determined from the gamma spectrum (1.18×10^{-3} g K/pc K^{40}). Counting times of 50 minutes are used for gamma spectroscopy.

Table 1 shows the approximate total analytical error (including counting error) associated with radionuclide concentrations in milk. These errors were determined by comparing the results of a large number of analyses. The ±2 standard deviations (2σ)

about the measured concentration corresponds to a 95% certainty that the true concentration is within this range. The minimum detectable concentration is defined as the measured concentration at which the two-standard deviation analytical error is equal to the measurement. Accordingly, the minimum detectable concentrations in units of pc/liter are Sr^{89}, 5; Sr^{90}, 2; Cs^{137}, 10; Ba^{140}, 10; and I^{131}, 10. At these levels and below the counting error comprises nearly all of the analytical error.

Table 1. Analytical errors associated with estimated concentrations for selected radionuclides in milk.

Nuclide	Estimated Concentration (pc/liter)	Error* (pc/liter)	Estimated Concentration (pc/liter)	Error* (Per cent of Concentration)
Iodine-131	0 to 100	±10	100 or greater	±10%
Barium-140	0 to 100	±10	100 or greater	±10%
Cesium-137	0 to 100	±10	100 or greater	±10%
Strontium-89	0 to 50	±5	50 or greater	±10%
Strontium-90	0 to 20	±2	20 or greater	±10%

*Two standard deviations (2σ)

Chapter 3
RESULTS

Table 2 lists the twenty-six announced events conducted during Operation Storax. The operation was divided into four sections: Operation Storax I, July 1, 1962 - September 30, 1962; Operation Storax II, October 1, 1962 - December 31, 1962; Operation Storax III, January 1, 1963 - March 31, 1963; and Operation Storax IV, April 1, 1963 - June 30, 1963.

Two of the twenty-six events listed released activity which was subsequently detected in the off-site area. These were the Bandicoot Event of October 19, 1962, and the Yuba Event of June 5, 1963. A summary of these two events appears in this section. Following the Wichita Event of July 27, 1962, a trace of I^{131} was detected on a charcoal cartridge air filter operating at Lathrop Wells, Nevada on July 28. A review of the other data collected following this event indicated, however, that the trace of I^{131} was not necessarily attributable to the Wichita Event. This event is, therefore, considered as not having been detected off-site.

The remaining twenty-four events produced no activity that was detected in the off-site area.

A. SUMMARY OF TWO EVENTS

1. Bandicoot

The tenth announced event of the Operation Storax series was Bandicoot. This was an underground test conducted in Area 3 at 1100 hours PDT on October 19, 1962, by the Los Alamos Scientific Laboratory.

Table 2. List of announced events for Operation Storax, July 1, 1962 - June 30, 1963.

No.	Event	Description	Area	Laboratory*	Date	Time
		OPERATION STORAX I				
1	Merrimac	Well	3	LRL	7/13/62	0900 PDT
2	Wichita	Well	9	LRL	7/27/62	1400 PDT
3	York	Well	9	LRL	8/24/62	0800 PDT
4	Bobac	Well	3	LASL	8/24/62	1000 PDT
5	Hyrax	Well	3	LASL	9/14/62	1010 PDT
6	Peba	Well	3	LASL	9/20/62	1000 PDT
7	Allegheny	Well	9	LRL	9/29/62	1000 PDT
		OPERATION STORAX II				
8	Mississippi	Well	9	LRL	10/05/62	1000 PDT
9	Roanoke	Well	9	LRL	10/12/62	0800 PDT
10	Bandicoot	Well	3	LASL	10/19/62	1100 PDT
11	Santee	Well	10	LRL	10/27/62	0800 PDT
12	Anacostia**	Well	9	LRL	11/27/62	1000 PST
13	Tendrac	Well	3	LASL & UK	12/07/62	1100 PST
14	Madison	Tunnel	12	LRL	12/12/62	0925 PST
15	Numbat	Well	3	LASL	12/12/62	1045 PST
		OPERATION STORAX III				
16	Casselman	Well	9	LRL	2/08/63	0800 PST
17	Acushi	Well	3	LASL	2/08/63	1000 PST
18	Carmel	Well	2	LRL	2/21/63	1147 PST
19	Kaweah	Well	9	LRL	2/21/63	1147 PST
20	Gerbil	Well	3	LASL	3/29/63	0749 PST
		OPERATION STORAX IV				
21	Ferret Prime	Well	3	LASL	4/05/63	0952 PST
22	Stones	Well	9	LRL	5/22/63	0840 PDT
23	Yuba	Tunnel	12	LRL	6/05/63	1000 PDT
24	Hutia	Well	3	LASL	6/06/63	0700 PDT
25	Mataco	Well	3	LASL	6/14/63	0710 PDT
26	Kennebec	Well	2	LRL	6/25/63	1600 PDT

*Laboratory abbreviations are as follows: LASL - Los Alamos Scientific Laboratory; LRL - Lawrence Radiation Laboratory; UK - United Kingdom.

**The Anacostia Event was a Plowshare experiment but has been included in this report, as a separate report of this event is not justified.

The Bandicoot Event resulted in the release of radioactive material. Upper level wind directions during and after the event were primarily toward the south. Surface winds were to the north, or variable, depending on the geographic location. As a result, activity was detected north, south, and west of surface Ground Zero, and a small amount was detected to the east.

The maximum radiation intensity detected by ground monitoring in the off-site area was 20 mr/hr on Highway 95, seven miles west of the turnoff to Mercury at 1430-1440 hours. The maximum radiation intensity detected during ground remonitoring the next day was 1.5 mr/hr on Highway 95, 4.6 miles west of the Mercury turnoff.

The highest concentration of gross beta activity on collected air samples was 52,000 pc/M^3 on the filter of the sampler at Death Valley Junction, California. This sampler ran from 1538 to 1630 hours on October 19, 1962.

a. Surveillance

A USAF U3-A aircraft and crew were supplied for use by a two man PHS monitoring team.

Eight mobile monitoring teams conducted the ground monitoring on the day of the event, and six teams conducted the monitoring for residual contamination on the following day.

Environmental surveillance consisted of Eberline RM-5 recorders located at three populated locations, twenty-eight permanent air sampling stations and five temporary air sampling stations, personnel and station film badges, and milk and water sampling. Locations of air sampling stations are shown in Figure 1.

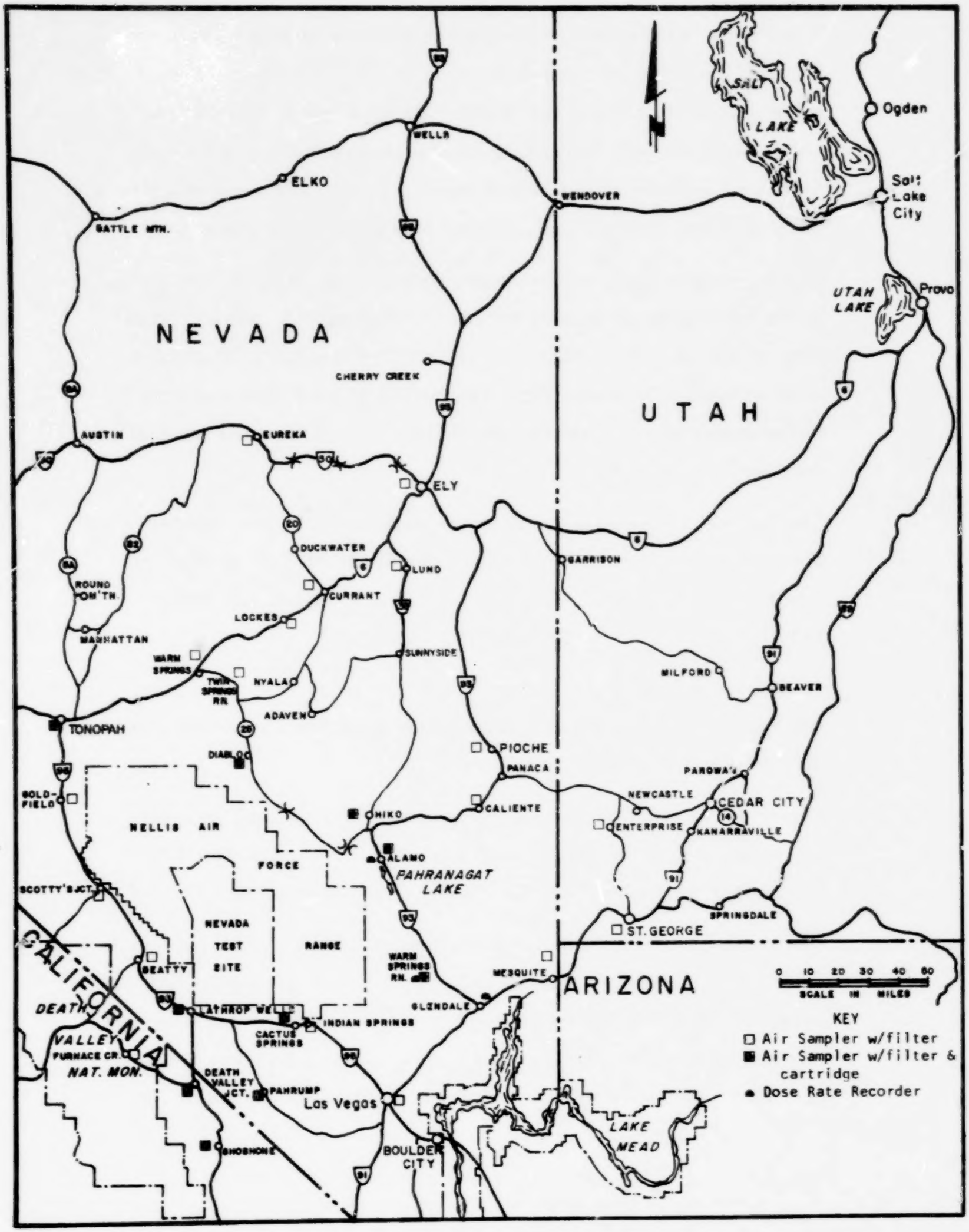

Figure 1. Air sampling stations, Bandicoot, October 19, 1962.

b. Results

Aerial Monitoring

Cloud position reports from the aerial monitoring aircraft documented the spreading effect of the Bandicoot effluent. The major portion of the effluent moved southward at approximately sixteen miles per hour, while a smaller portion moved slowly northward. The northbound cloud remained near the surface, while the southbound portion extended from about 5,600 feet Mean Sea Level (MSL) to 10,000 feet MSL.

The cloud followed the north and south trajectories until approximately 1300 hours, when it began to spread westward in addition to its north and south expansion. The approximate boundaries of the cloud were reported by the aircraft crew and ground monitoring units until 1700 hours. After that time, according to data gathered by other agencies, the cloud continued to expand westward and ultimately moved southwest and passed over the Los Angeles, California area.

Ground Monitoring

Initial contact with the radioactive cloud in the off-site area was made as it crossed Highway 95 just south of the test range complex. Maximum radiation intensities obtained were 20 mr/hr seven miles west of the Mercury turnoff - Highway 95 junction on Highway 95. These radiation intensities were obtained from 1430 to 1440 hours. At Ash Meadows a radiation intensity of 0.55 mr/hr was obtained at 1520 hours.

Maximum radiation intensities obtained at various populated locations are shown in Table 3. Residual radiation intensities found in populated locations are shown in Table 4.

Table 3. Summary of ground monitoring - October 19, 1962.

Time (PDT)	Location	Azimuth* (degrees)	Distance (miles)	Net Dose Rate (mr/hr)**
1452	Cactus Springs, Nevada	153	35	0.58
1456	Indian Springs, Nevada	148	37	0.45
1530	Lathrop Wells, Nevada	217	34	0.5
1520	Ash Meadows, Nevada	199	49	0.6
1530	Death Valley Junction, Calif.	202	54	0.25
1720	Pahrump, Nevada	178	57	0.03
1615	Shoshone, California	190	75	0.03

Table 4. Summary of ground monitoring - October 20, 1962.

Time (PDT)	Location	Azimuth* (degrees)	Distance (miles)	Net Dose Rate (mr/hr)**
1145	Cactus Springs, Nevada	153	35	Zero
1158	Indian Springs, Nevada	148	37	Zero
0936	Lathrop Wells, Nevada	217	34	0.45
0900	Johnnie Mine, Nevada	184	40	0.22
0900	Beatty, Nevada	258	41	Zero
1020	Ash Meadows, Nevada	199	49	0.11
1028	Death Valley Junction, Calif.	202	54	0.07
1010	Furnace Creek, California	228	60	Zero
1720	Pahrump, Nevada	178	57	0.03
1200	Shoshone, California	190	75	0.04
1313	Nipton, California	158	115	Zero
1130	Baker, California	180	122	Zero
1420	Searchlight, Nevada	149	123	Zero
1715	Kingman, Arizona	138	168	Zero

*Azimuth and distance are from ground zero.
**All readings taken at three feet above ground.

Dose Rate Recorders

A dose rate recorder placed at Alamo showed background dose rates; another at Glendale Junction failed to operate. A third unit at Warm Springs Ranch showed a peak gamma dose rate of 0.3 mr/hr at 1605 hours on October 19, 1962. By 1635 hours, radiation intensity had returned to background.

Film Badges

Although some of the film badges collected following the Bandicoot Event showed positive exposures, they are believed to be the result of earlier nuclear events. Positive film badge results for the entire operation are listed in Table 7.

Air Sampling

The results of gross beta and isotopic analysis of air samples from populated locations are presented in Table 5. This table lists activity detected in both glass fiber prefilter and in charcoal cartridge filters.

In addition to the data presented, air sampling conducted by the California State Health Department indicated a peak gross beta activity concentration in air of approximately 40 pc/M^3 to have passed over Los Angeles between 0130 and 0500 hours on October 21, 1962. Based on meteorological data collected following this event, this activity was assumed to have been a result of the Bandicoot release.

As no definite times of peak cloud passage were available because of the "smearing" effect of the winds, all air activities that could be extrapolated, were extrapolated back to mid-point of collection time. Gross beta extrapolation was

Table 5. Air samples from populated locations from the Bandicoot Event of Operation Storax.

I. STATION LOCATION			II. COLLECTION DATA								III. RADIOASSAY DATA									
				SAMPLING PERIOD							GROSS β COUNT		GAMMA PULSE HEIGHT ANALYSIS							
				BEGIN			END						ACTIVITY (pc/M^3)							
STATION NAME	AZIMUTH (°)	DISTANCE (miles)	AIR VOLUME (M3)	Month	Day	Time	Month	Day	Time	COLLECTOR	CORR. TO:	AC-TIVITY (pc/M3)	CORR. TO:	I^{131}	I^{135}	I^{133}	Te^{132}	Ba-La^{140}	Zr-Nb^{95}	Ru^{103}
Alamo, Nev.	62	51	1101	10	19	1545	10	20	1015	F	CT	107	CT	1.9	50	ND	7.0	2.3	1.0	0.99
										C			MP	0.13	D	0.62	ND	ND	0.10	D
Beatty, Nev.	258	40	2450	10	19	1200	10	20	0900	F	MP	1050	MP	27	D	490	130	27	1.4	5.8
Cactus Spgs., Nevada	152	35	931	10	19	1805	10	20	1127	F	MP	2300	MP	74	D	340	390	77	D	7.3
										C			MP	9.0	46	900	D	1.3	ND	ND
Death Valley Jct., Calif.	220	54	45	10	19	1538	10	19	1630	F	MP	52000	MP	102	D	345	7.7	163	12.2	4.7
Diablo, Nev.	358	52	1278	10	19	1410	10	20	1800	F	CT	40	CT	0.53	ND	ND	ND	1.0	1.1	0.50
										C			MP	0.20	ND	ND	ND	ND	0.16	0.19
Hiko, Nev.	47	58	857	10	19	0800	10	20	0800	F	MP	210	MP	1.0	ND	ND	ND	1.2	1.4	1.3
										C			MP	0.29	ND	ND	ND	ND	ND	0.24
Indian Spgs., Nevada	147	36	663	10	19	1840	10	20	1158	F	MP	2300	MP	69	D	570	340	60	D	6.0
										C			MP	7.2	160	270	19	3.7	ND	0.79
Lathrop Wells, Nevada	217	34	600	10	19	1530	10	20	0630	F	MP	6700	MP	270	D	D	1100	270	D	24
										C			MP	44	D	2500	120	2.5	ND	1.1
Pahrump, Nev.	178	56	802	10	19	1350	10	20	1300	F	MP	2000	MP	36	D	370	220	38	3.0	3.2
										C			MP	6.2	D	140	7.8	1.6	ND	ND
Searchlight, Nevada	149	123	436	10	21	0900	10	21	1800	F	MP	40	MP	2.0	ND	ND	ND	3.0	1.7	1.8
										C			MP	0.62	ND	ND	0.9	ND	0.33	0.40
Shoshone, California	190	74	962	10	19	1615	10	20	1205	F	MP	1040	MP	35	D	330	170	34	1.2	7.1
										C			MP	5.2	D	18	7.9	1.8	ND	0.29
Warm Spgs. Ranch, Nev.	106	75	964	10	19	1730	10	20	1130	F	MP	280	MP	1.1	ND	ND	3.3	1.3	1.5	1.6
										C			MP	0.22	ND	ND	ND	ND	ND	0.76

CT = Time of Count
MP = Mid Point of Collection Period
ND = Not Detected
D = Detected in amounts too small to quantitate
F = 8" x 10" glass fiber filter
C = MSA Charcoal Cartridge

accomplished either graphically from an empirically derived decay factor or calculated using a $T^{-1.2}$ decay factor, depending on the type of sample and decay data available. Gross beta decay curves of filters from locations directly in the cloud path appeared to indicate an unfractionated fission product release.

Milk Results

The results from milk samples collected following the Bandicoot Event are listed with the results of all milk sampling during the Storax series in Appendix A.

Water Results

Gross beta analysis of water samples from supplies used for human consumption gave the results shown in Table 6. These values are within the range of natural background for these areas.

Table 6. Gross beta results of potable water samples collected following the Bandicoot Event.

Location	Date Collected (1962)	Gross Beta Activity (pc/l)
Alamo, Nevada	11/16	25
Ash Meadows, Nevada	11/16	9
Beatty, Nevada	11/15	4
Butler Ranch, Nevada (unpopulated)	11/20	<1
Cactus Springs, Nevada	12/12	3
Furnace Creek, California	11/16	10
Lathrop Wells, Nevada	11/15	4
Pahrump, Nevada	11/16	4
Warm Springs Ranch, Nevada	11/16	16

2. Yuba

The twenty-first announced event of Operation Storax was Yuba, an underground test conducted in an Area 12 tunnel at 1000 hours PDT, on June 5, 1963, by the Lawrence Radiation Laboratory.

The Off-Site Radiological Safety Program detected no activity above background levels by ground and aerial monitoring or air sampling on the day of the event. A release during sample recovery operations several days after the event resulted in a small amount of I^{131} being detected on an activated charcoal cartridge air filter at Lathrop Wells, Nevada. The amount detected was too low to be quantitated.

No unusual peaks of gross beta activity appeared on any of the prefilters collected at the thirty-two routine air sampling stations operating during this period.

No other indication of off-site exposure from the Yuba Event could be documented.

B. RESULTS FROM ROUTINE AIR SAMPLING AND DOSIMETRY NETWORK

1. Graphical Representation of Results from the Air Sampling Network

Graphs in Figure 2 show the concentration of gross beta activity in air collected on glass fiber filters at each air sampling station for the period covered by the Storax series. These graphs were prepared by a Bensen-Lehner plotter and represent the extrapolated activity as a function of time. In some cases, the activity at time of count was used when the second count was as high or higher than the first count. The accuracy of this procedure is approximately $\pm$ 10%; therefore, a precise numerical value cannot be obtained from these graphs.

In general, it can be noted from these graphs that most fluctuations are within a factor of ten of the mean. The anomalies occurring in July and October are attributed to the previously mentioned Sedan experiment, Operation Dominic II, and the Bandicoot Event respectively. It should be noted, however, that radioactive effluent from United States atmospheric tests in the Pacific Ocean and atmospheric tests by the U.S.S.R. was present throughout the United States during most of the Storax series and did cause fluctuations in air concentrations and in I^{131} detected in milk.

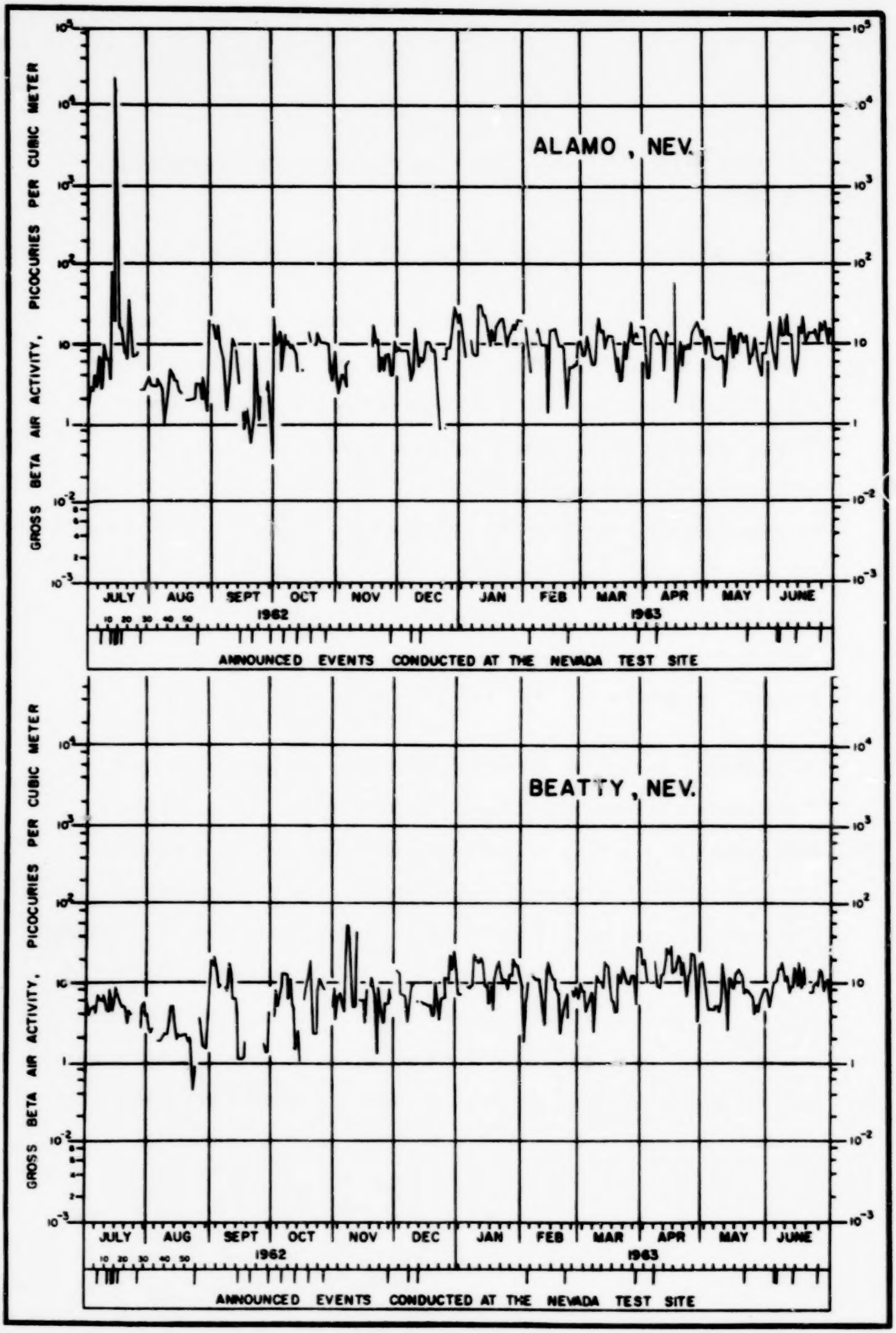

Figure 2. Air sampling results, Operation Storax.

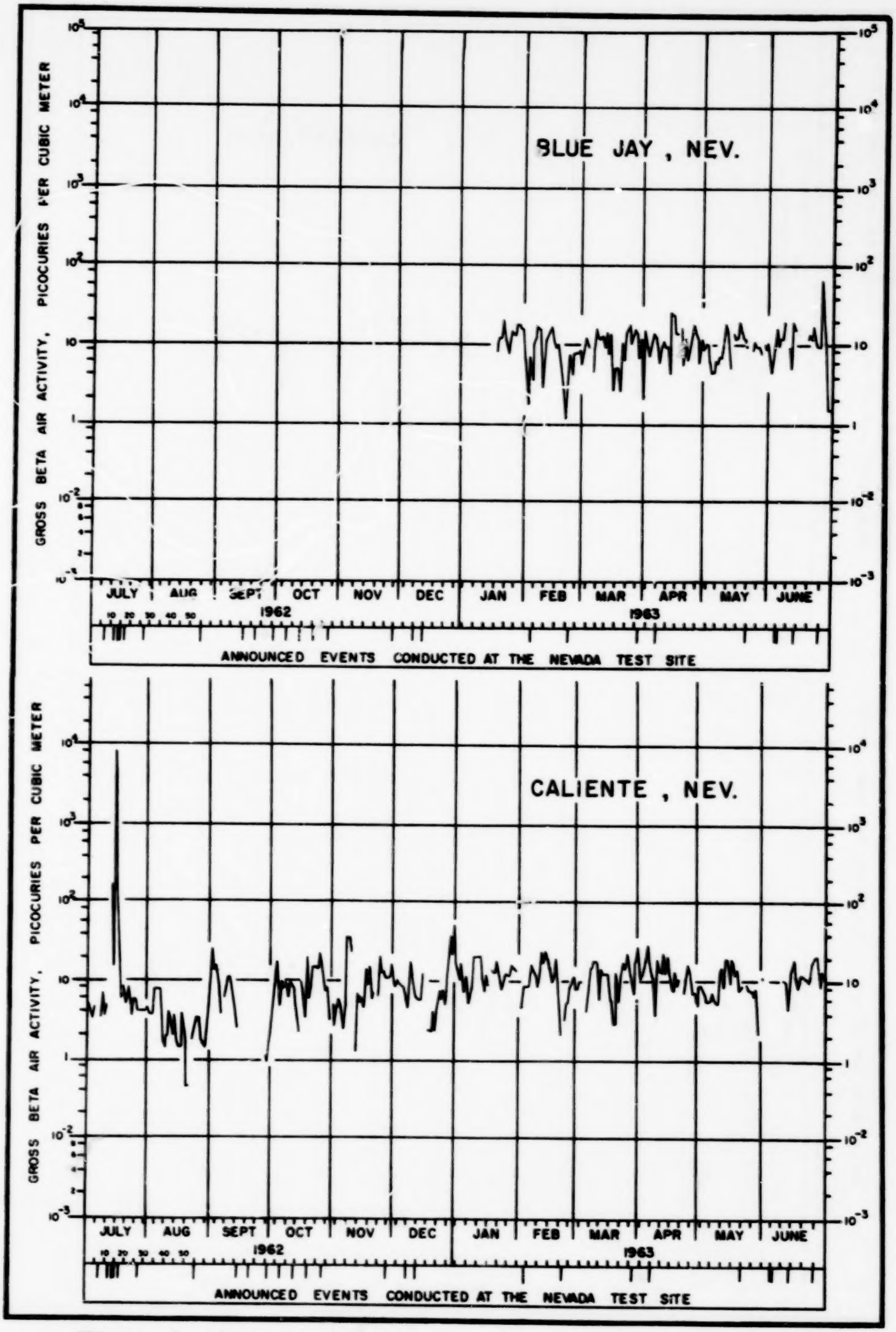
BLUE JAY , NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
CALIENTE , NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

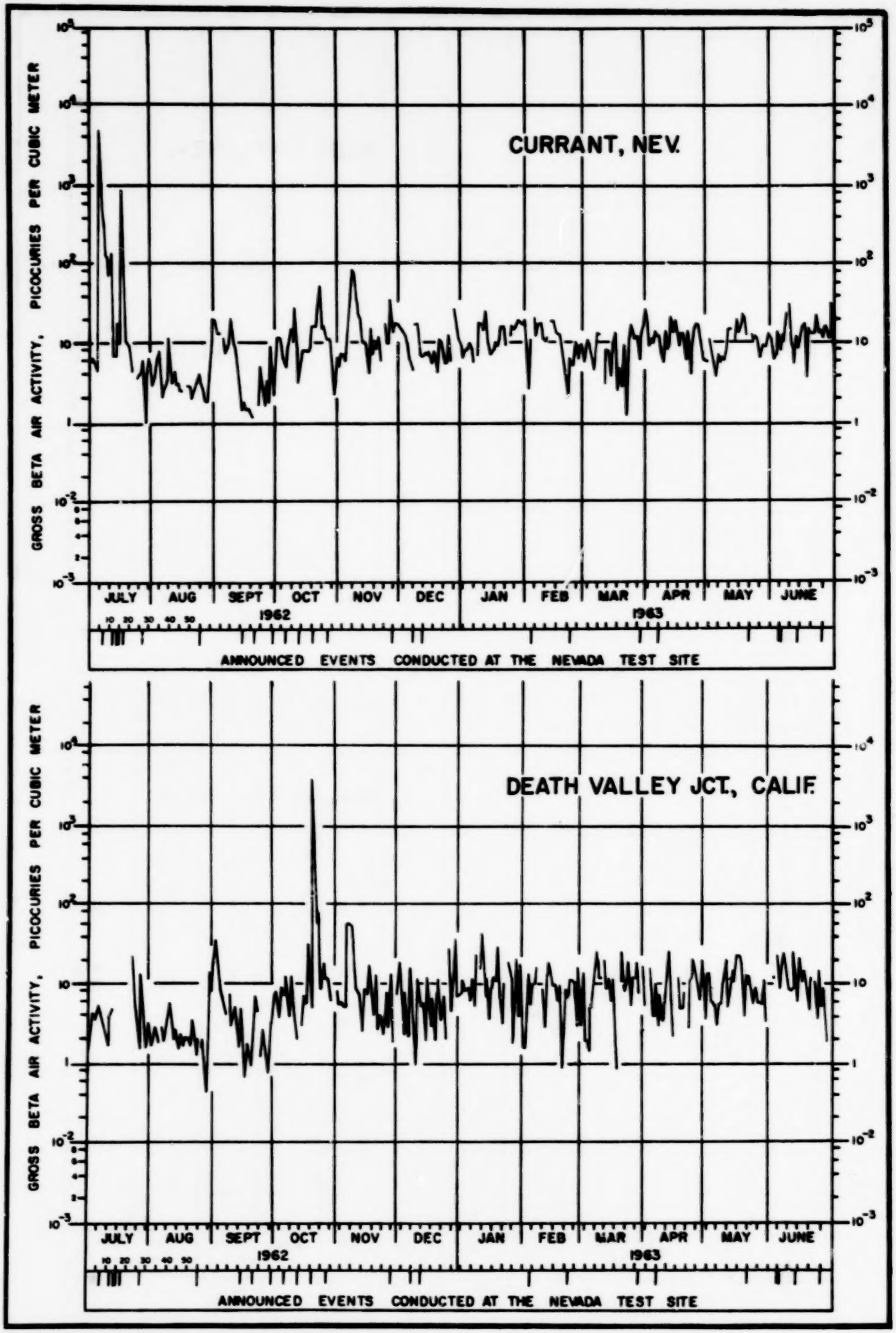
CURRANT, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
DEATH VALLEY JCT., CALIF.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

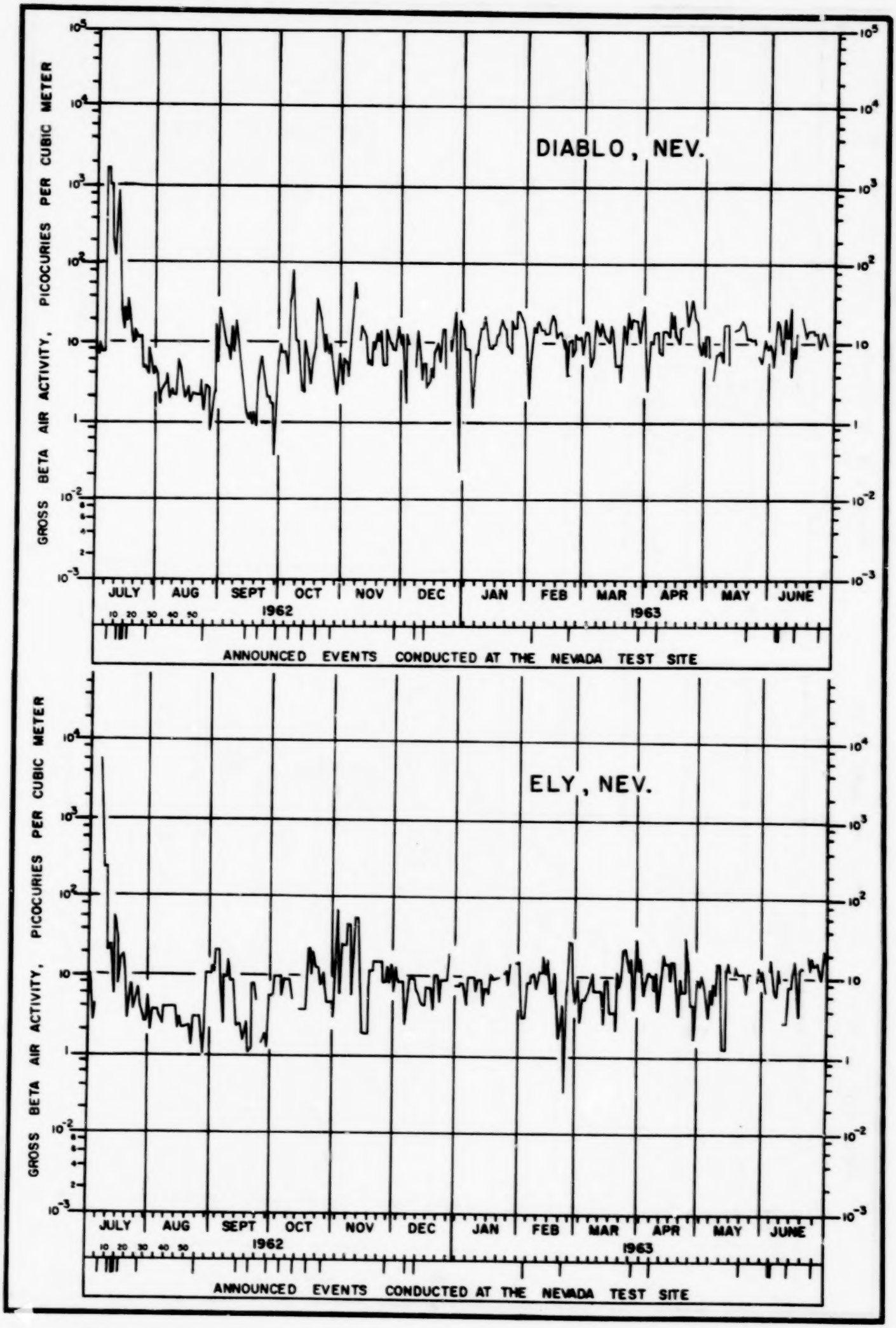
DIABLO, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
ELY, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

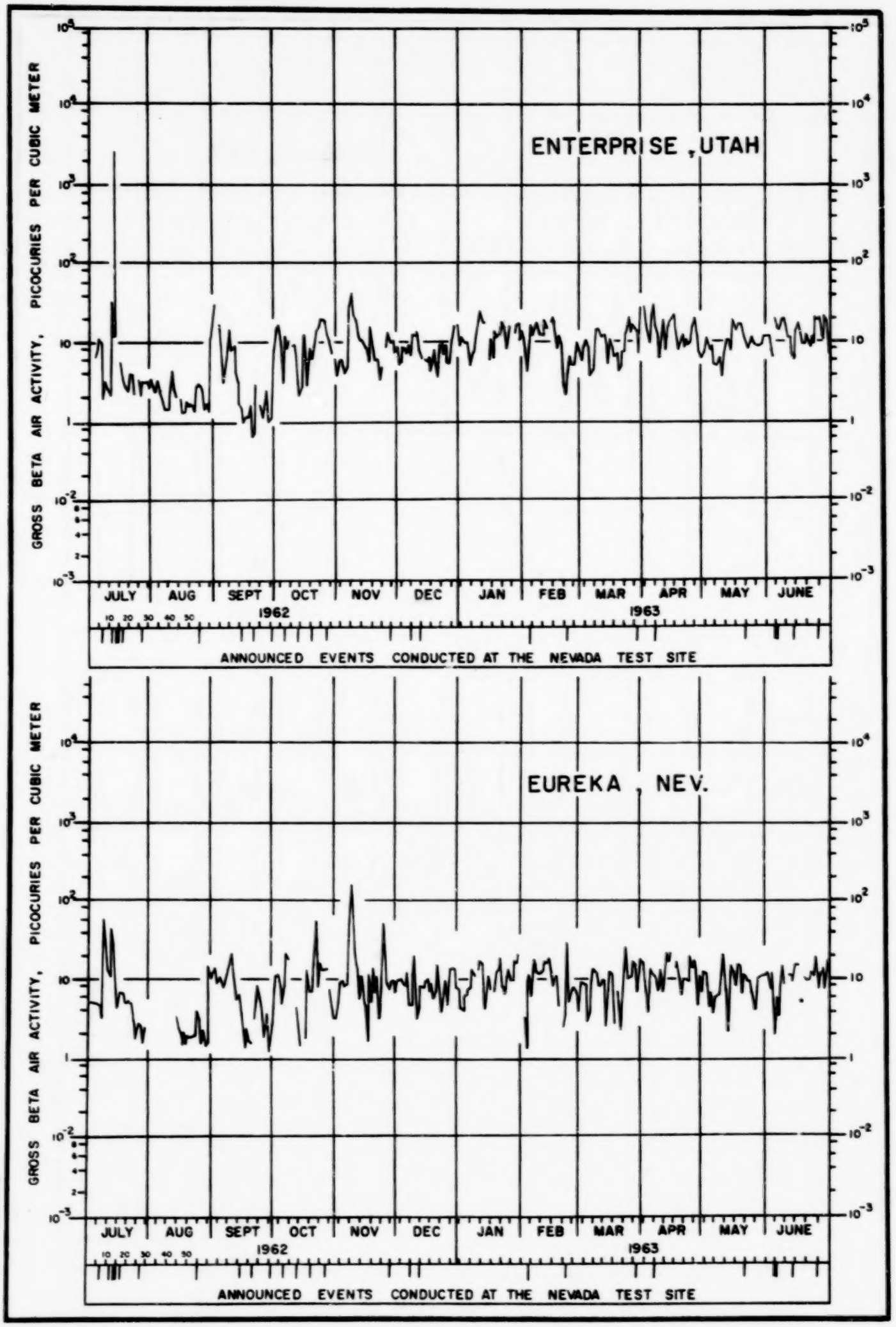

Figure 2. Air sampling results, Operation Storax (continued).

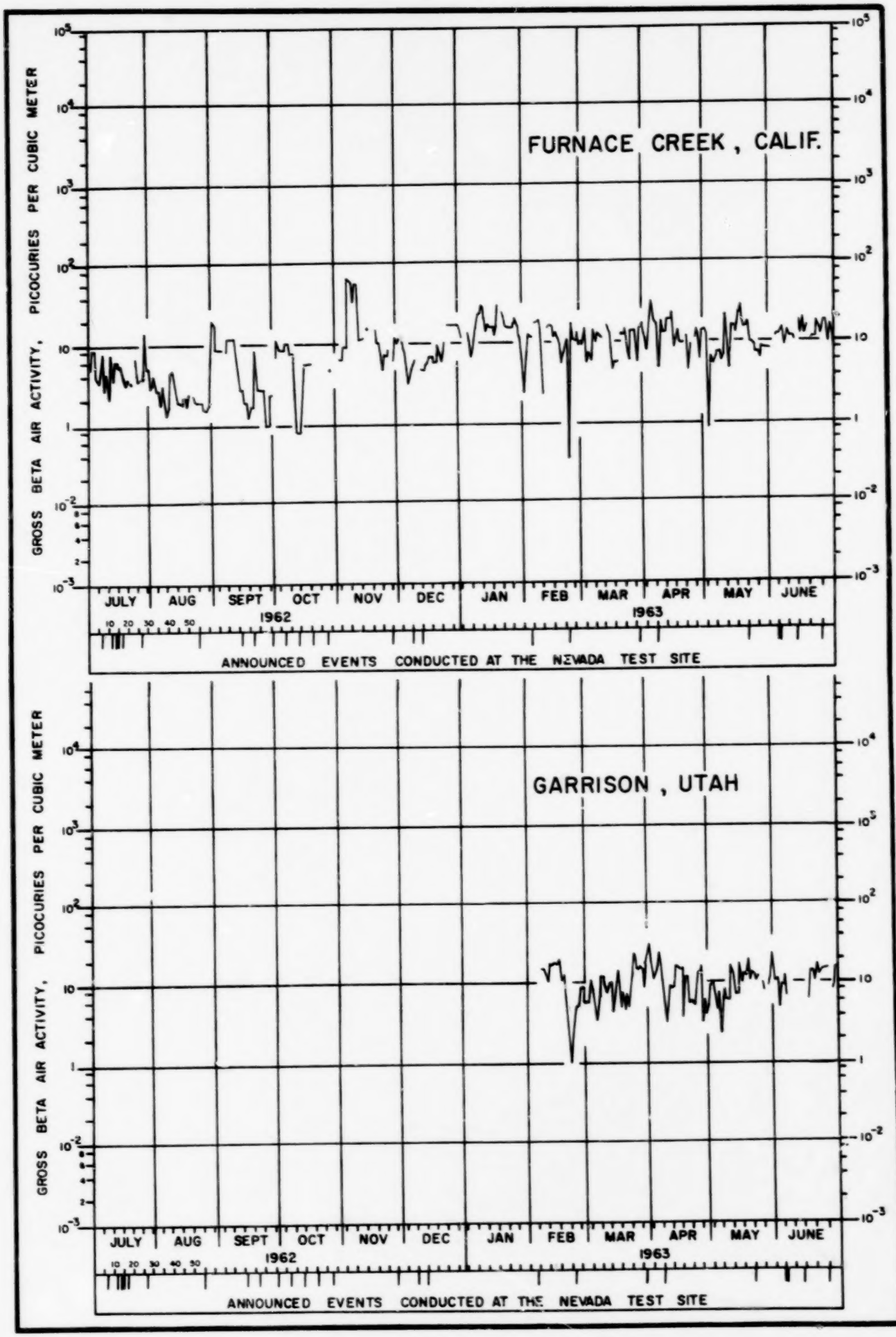

Figure 2. Air sampling results, Operation Storax (continued).

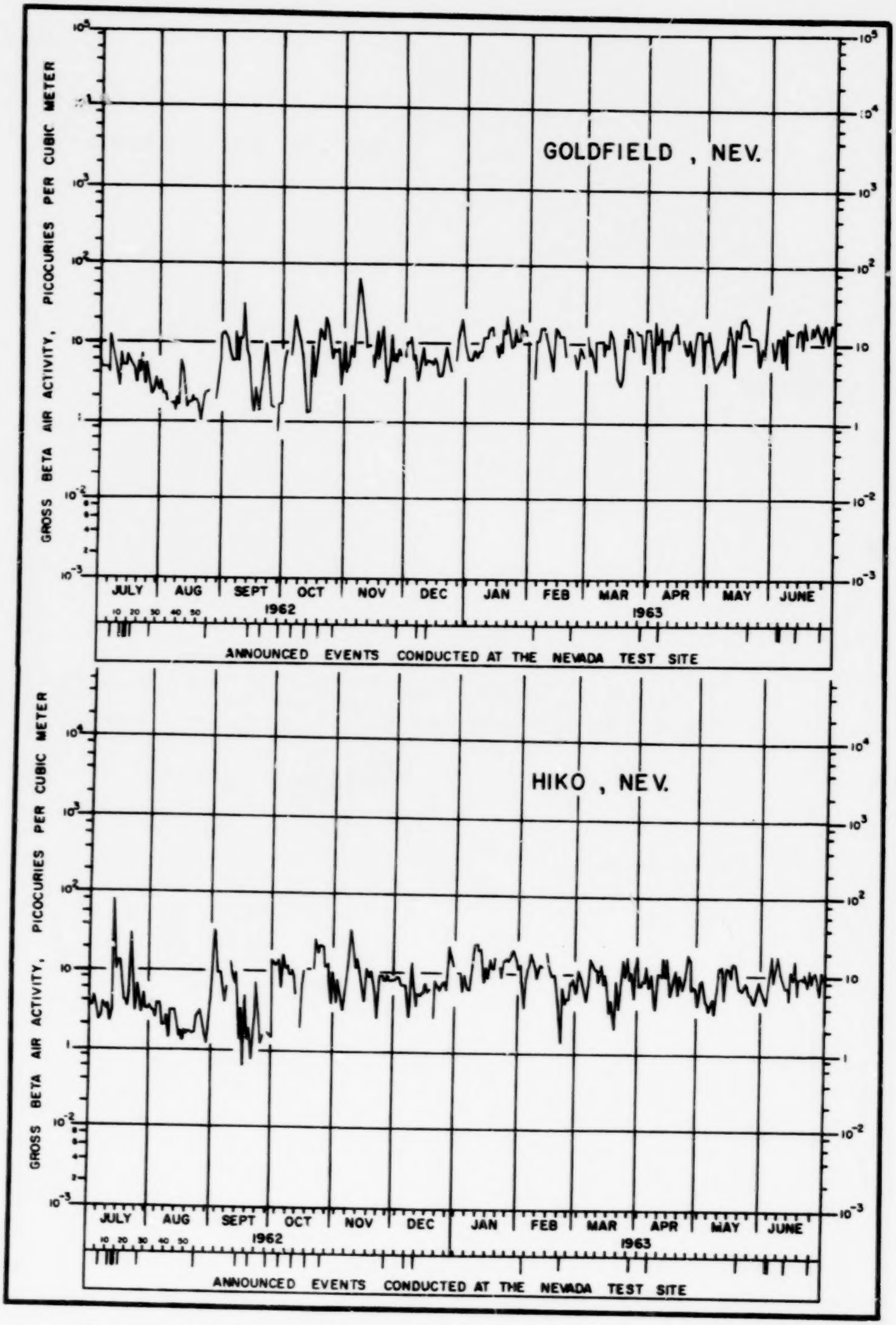

Figure 2. Air sampling results, Operation Storax (continued).

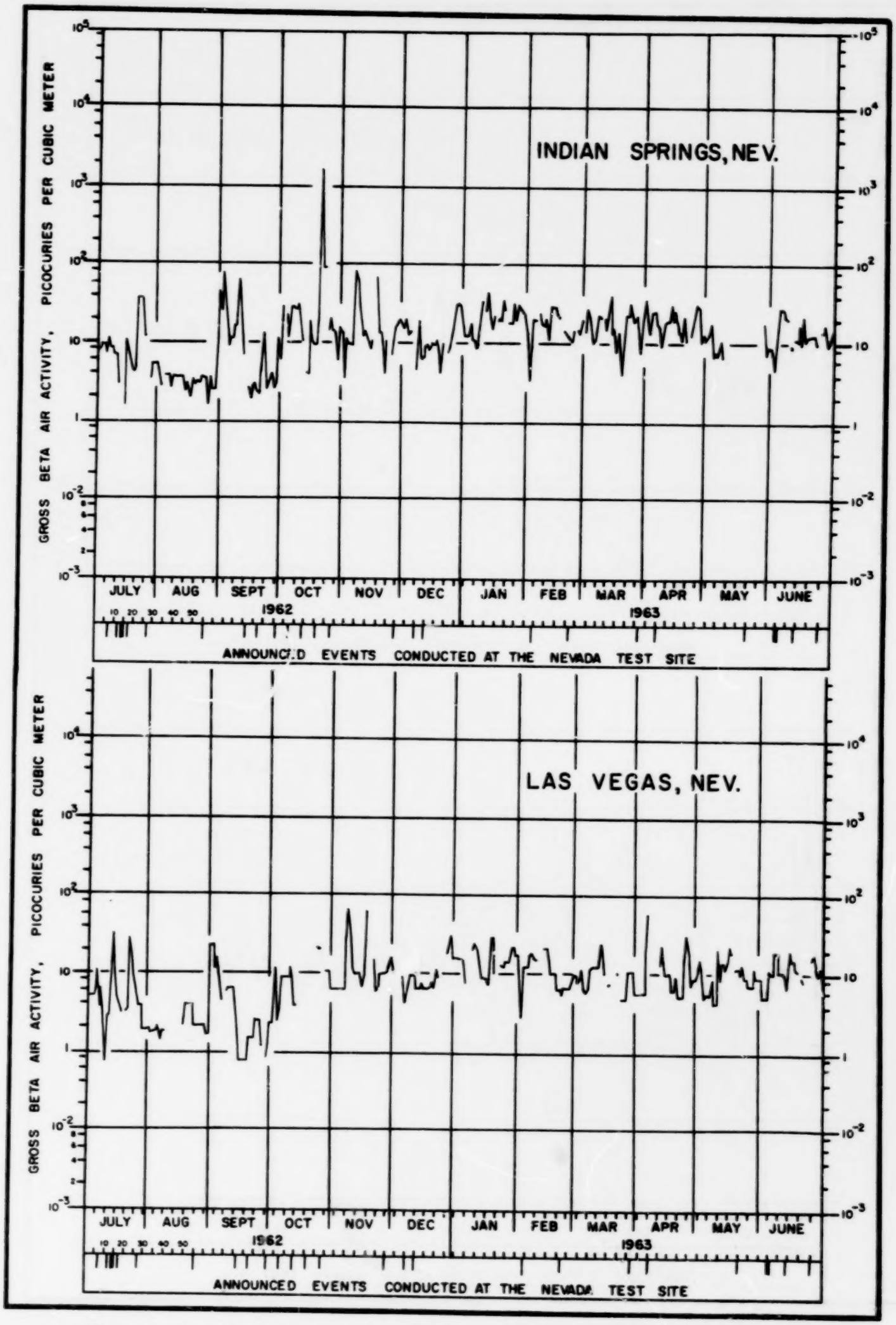
INDIAN SPRINGS, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
LAS VEGAS, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

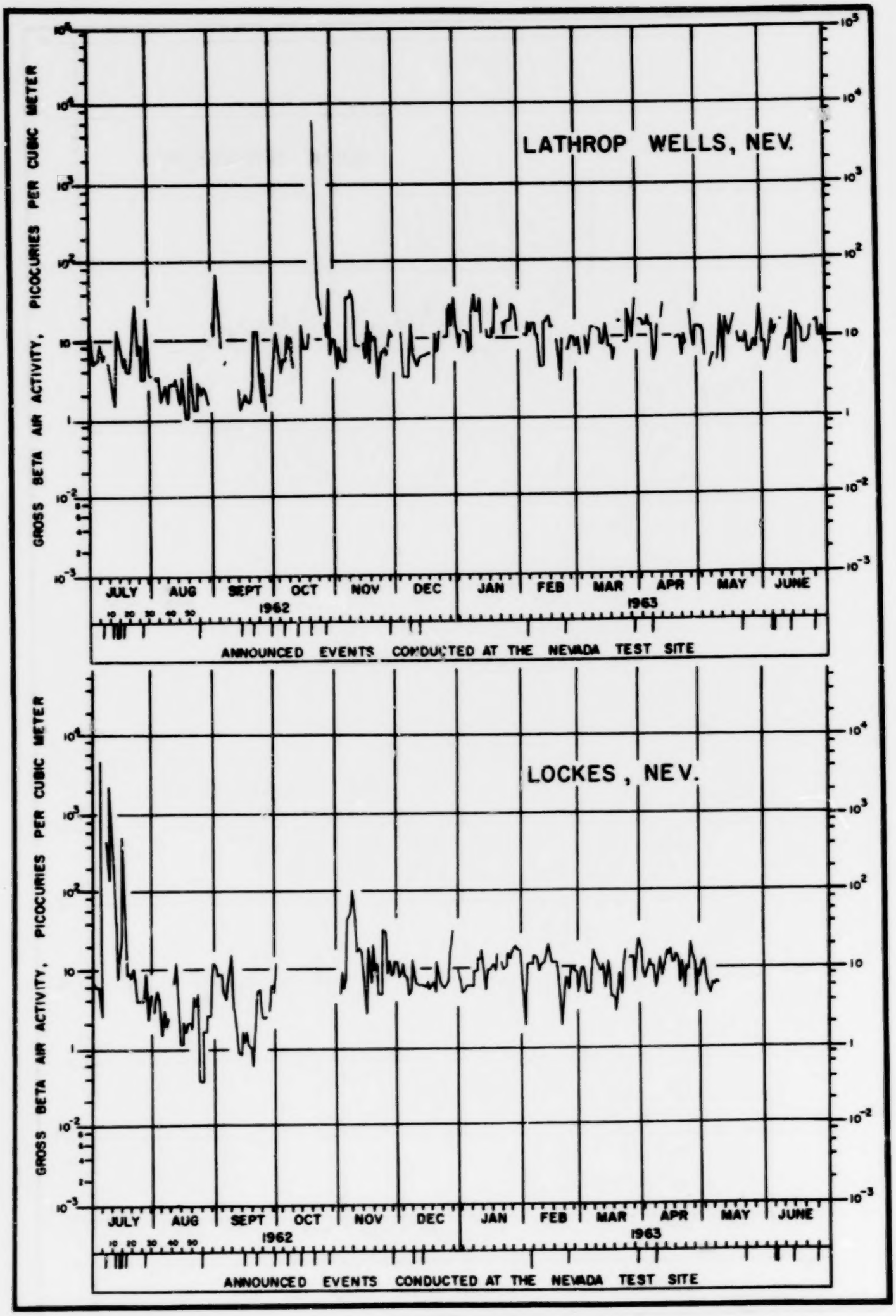
LATHROP WELLS, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
LOCKES, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

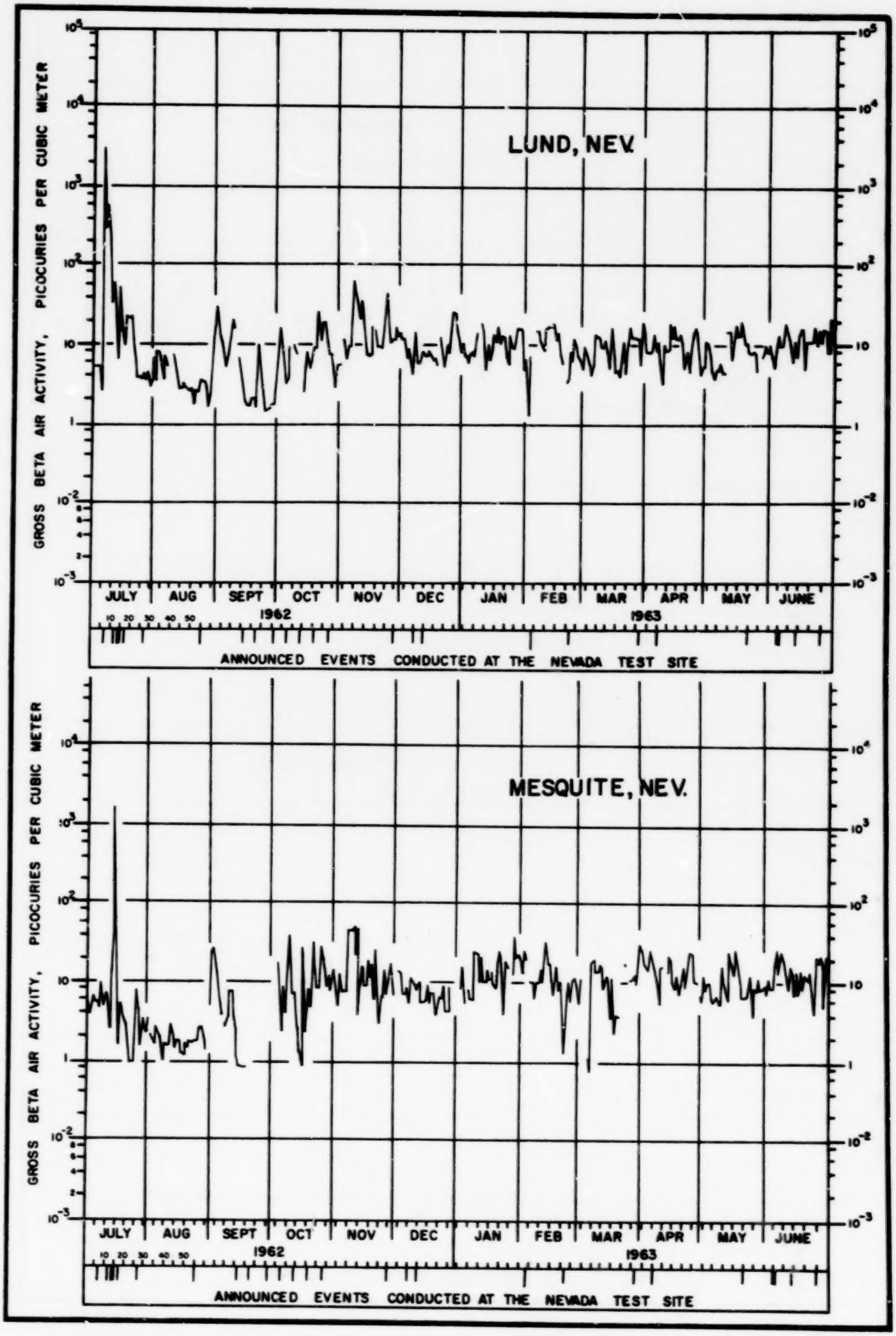
LUND, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
MESQUITE, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

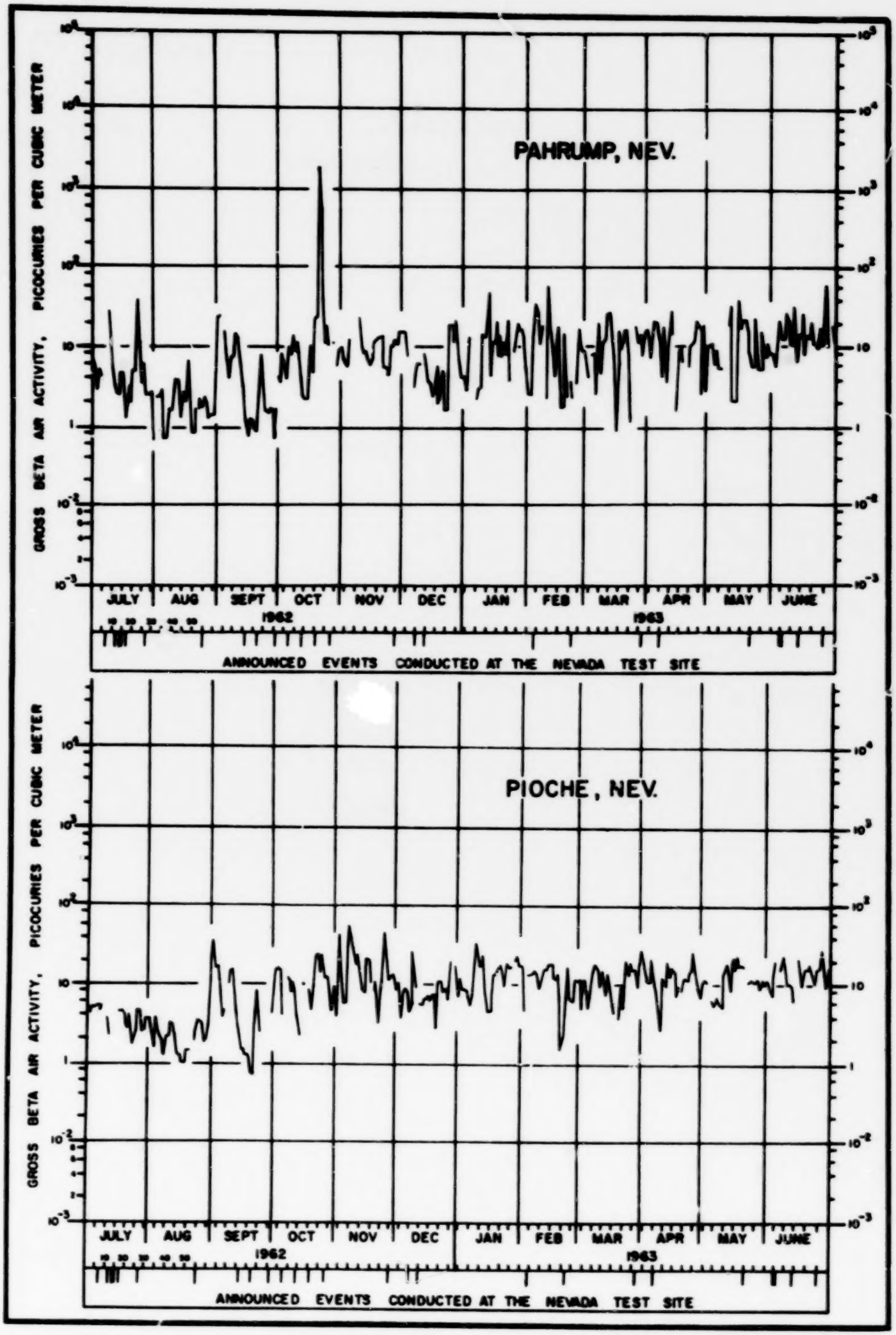

Figure 2. Air sampling results, Operation Storax (continued).

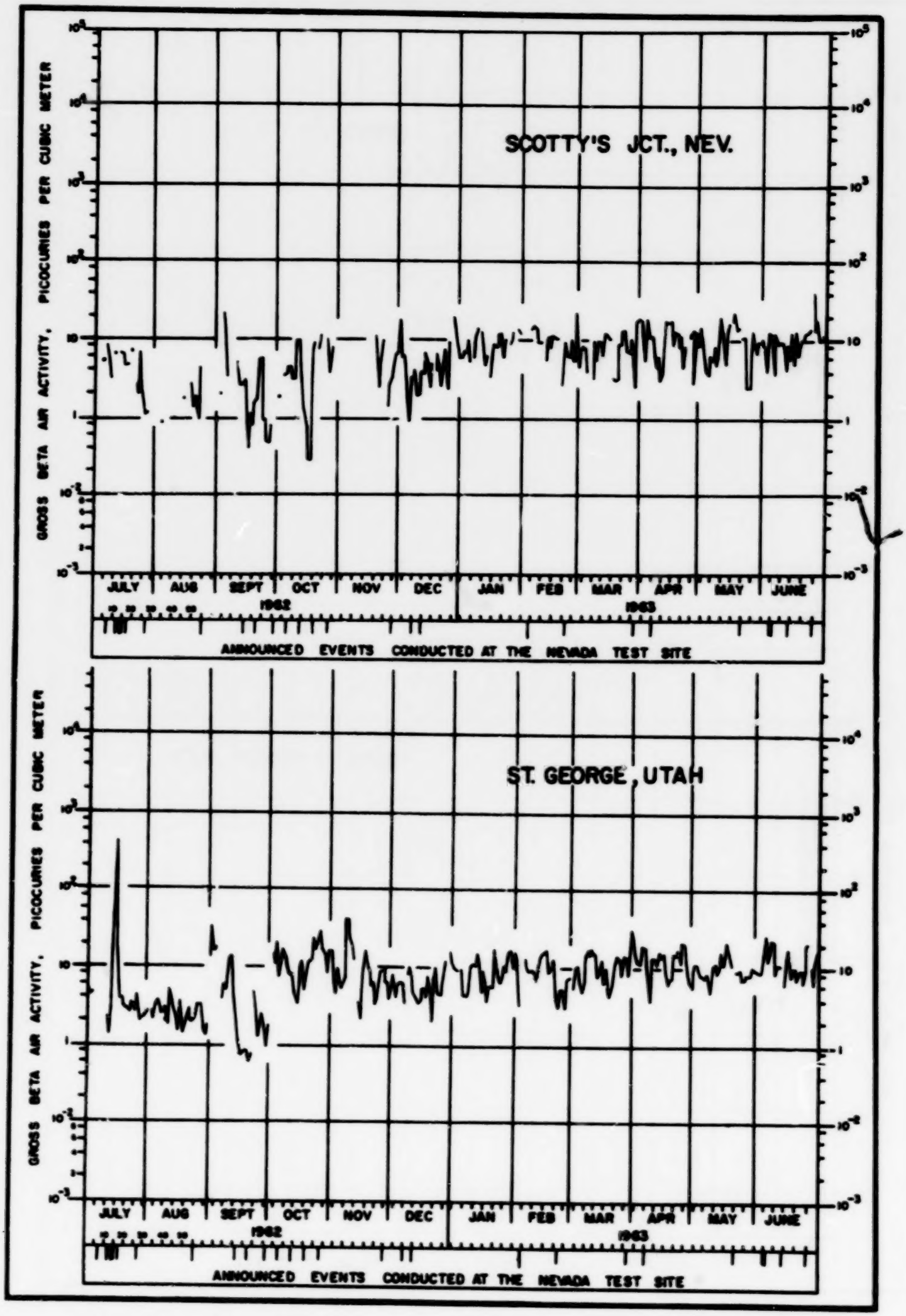

Figure 2. Air sampling results, Operation Storax (continued).

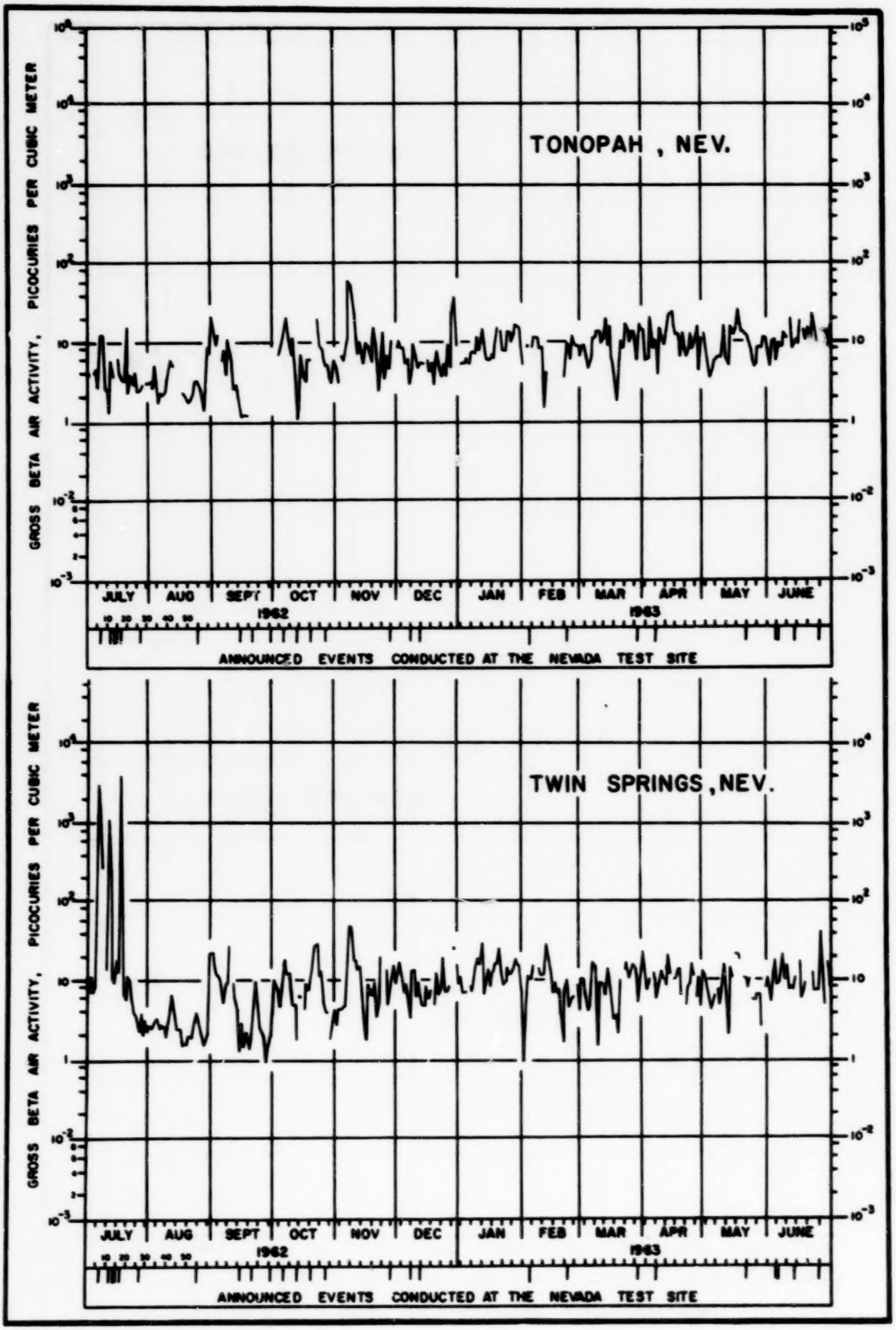
TONOPAH , NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
TWIN SPRINGS, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

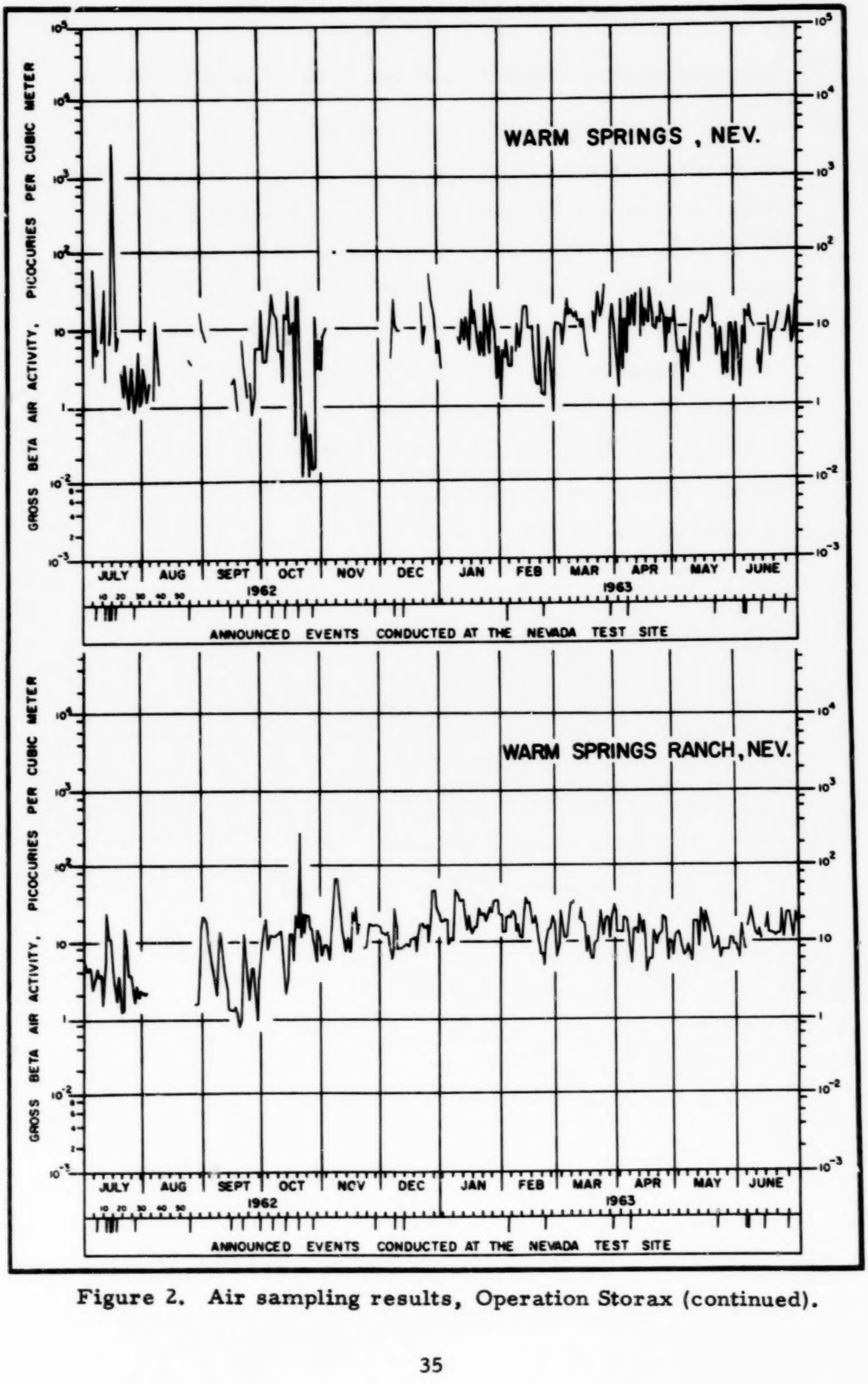
WARM SPRINGS , NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE
WARM SPRINGS RANCH, NEV.
GROSS BETA AIR ACTIVITY, PICOCURIES PER CUBIC METER
JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE
1962
1963
ANNOUNCED EVENTS CONDUCTED AT THE NEVADA TEST SITE

Figure 2. Air sampling results, Operation Storax (continued).

2. Summary of Film Badge Exposures During Operation Storax

Analysis of film badge exposures during the Storax series indicated there were no exposures attributable to any Storax events. Film badges that did indicate exposures above the 30 mr detection level are listed in Table 7. These exposures were probably the result of the Sedan and/or Dominic II events. For a listing of other film badges attributed to these events, consult "Final Report of Off-Site Surveillance for Operation Dominic II, July 1962" (SWRHL-3r) and "Final Off-Site Report of the Project Sedan Event" (PNE-200F). During the Storax series, film badges were regularly exchanged at approximately 65 stations and for 200 individuals.

Table 7. Personnel and station film badges collected during Operation Storax showing positive results.

LOCATION	EXPOSURE PERIOD	DOSE (mr)
PERSONNEL FILM BADGES		
Adaven, Nevada	8/08-10/03	95
	8/08-10-03	70
Beatty, Nevada	9/24-11/01	85
Blue Eagle Ranch	8/10-09/06	40
Caliente, Nevada	7/26-08/28	140
	7/26-08/28	50
Casey Ranch	8/08-12/05	100
Diablo, Nevada	10/04-12/05	60
Duckwater, Nevada	8/09-09/04	45
	9/04-10/09	35
Gardner Ranch	8/09-09/05	45
Goss Ranch	7/19-08/16	80
	7/19-08/16	90
Hot Creek Ranch	7/20-08/16	200
	8/16-10/24	360
Manzonie Ranch	8/10-09/04	45
	8/10-09/04	40
	7/10-09/03	50
Penoyer Ranch	7/19-08/16	65
	7/19-08/16	75
Rattlesnake Maintenance Station	7/20-08/16	70
	7/20-08/16	55
Twin Springs Ranch	8/16-10/24	105
	10/24-12/05	50
Warm Springs, Nevada	7/19-08/16	65
	7/19-08/16	65

Table 7. Personnel and station film badges collected during Operation Storax showing positive results. (continued)

LOCATION	EXPOSURE PERIOD	DOSE (mr)
STATION FILM BADGES		
Adaven, Nevada (Simpson Ranch)	8/08-10/03	95
	10/03-12/05	50
Blue Eagle Ranch	8/10-09/05	50
Currant Maintenance Station	8/09-09/04	30
Duckwater, Nevada	8/09-09/04	45
Hot Creek Ranch	10/24/62-1/15/63	30
Lincoln Mine	5/09-06/18/63	47
Lockes, Nevada	8/10-09/04	30
	9/04-10/06	30
Lower Pahranagat Lake	7/26-08/17	114
	8/17-09/12	88
Pahranagat Lake	5/08-06/10/63	27
Penoyer Ranch	8/01-09/26	135
Pine Creek, Nevada	10/03/62-1/16/63	85
Rattlesnake Maintenance Station	7/20-08/16	65
Reed, Nevada	8/01-09/26	420
	5/09-06/18/63	73
Shell Oil Site	8/10-09/05	50
Stone Cabin Ranch	5/01/63-6/20/63	55
Uhalde Ranch	8/08-10/03	65
	10/03-01/16/63	70

Chapter 4

CONCLUSIONS

Careful analysis of all air, milk, and water sampling, as well as ground and aerial monitoring for the events of Operation Storax indicate that exposures to the off-site population were below the safety criteria established by the Atomic Energy Commission.

APPENDIX A

RESULTS OF MILK SAMPLE ANALYSES, OPERATION STORAX

This Appendix is comprised of data obtained from milk samples collected from August 1962 through June 1963. Results of milk samples taken during July 1962 were reported in "Final Report of Off-Site Surveillance for Operation Dominic II", (SWRHL-3r).

During the entire period of Operation Storax, world-wide fallout was a contributing factor to radionuclide concentration found in milk. Fallout from the U.S. Pacific tests and the U.S.S.R. atmospheric tests was contributing measurable amounts of I^{131} to the United States milk supply through late 1962 and well into 1963, demonstrated by the sample taken at Eunice, New Mexico on November 2, 1962. However, during the early part of the operation, concentrations in milk were largely the result of the Sedan Experiment, the events of Operation Dominic II, and the Bandicoot event. The rather extensive milk sampling program instituted in July 1962 for surveillance of the Sedan Experiment and Operation Dominic II was continued through August 1962 because positive values were still being obtained.

Appendix A - Results of Milk Sample Analyses, Operation Storax

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
	August 1962							
Anderson Dairy								
Las Vegas, Nevada	8/02/62	30	4	260	20	40	1.02	1.7
Arden Dairy								
Las Vegas, Nevada	3/01/62	15	3	60	10	20	1.06	1.8
Bliss Dairy								
Las Vegas, Nevada	8/01/62	20	7	50	<20	40	1.01	1.8
Clark Dairy								
Las Vegas, Nevada	8/01/62	15	2	50	<20	30	1.06	1.7
Hinie's Dairy								
Las Vegas, Nevada	8/01/62	15	2	50	<20	15	1.02	1.8
Meadow Gold Dairy								
Las Vegas, Nevada	8/01/62	25	9	50	<20	60	1.01	1.7
Alamo								
Nevada	8/01/62	-	-	360	<20	50	-	1.7
	8/02/62	-	-	420	<20	35	-	1.7
	8/03/62	-	-	210	20	30	-	1.6
	8/04/62	11	3	220	<20	30	-	1.7
	8/05/62	-	-	200	<20	35	-	1.7
	8/06/62	-	-	240	<20	30	-	1.7
	8/07/62	-	-	170	<20	20	-	1.6

Appendix A- Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Alamo								
Nevada (Cont')	8/08/62	-	-	170	30	35	-	1.8
	8/09/62	-	-	130	20	30	-	1.7
	8/10/62	-	-	130	10	35	-	1.7
	8/11/62	-	-	130	20	25	-	2.0
	8/12/62	-	-	70	< 20	30	-	1.8
	8/13/62	-	-	90	< 20	30	-	1.7
	8/14/62	-	-	40	< 20	35	-	1.9
	8/16/62	-	-	20	30	20	-	1.5
	8/18/62	-	-	40	< 20	70	-	1.5
	8/19/62	-	-	40	< 20	20	-	1.5
	8/21/62	-	-	40	< 20	20	-	1.5
	8/27/62	-	-	50	< 20	< 20	-	1.6
Austin								
Nevada	8/10/62	30	8	20	< 20	25	1.11	1.1
	8/23/62	25	3	50	30	40	1.06	1.7
Battle Mountain								
Nevada	8/09/62	70	8	< 20	< 20	50	1.10	1.2
	8/23/62	50	7	< 20	< 20	70	1.04	1.5
Blue Eagle Ranch								
Nevada	8/12/62	270	10	230	60	120	0.96	1.3
	8/21/62	240	17	100	50	160	1.22	1.8
	8/28/62	-	-	60	50	120	-	1.6

Appendix A-Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Caliente Nevada	8/01/62	-	-	1000	20	45	-	1.4
	8/02/62	-	-	830	40	40	-	1.2
	8/03/62	-	-	520	<20	45	-	1.7
	8/04/62	-	-	450	<20	25	-	1.5
	8/05/62	-	-	420	<20	15	-	1.5
	8/06/62	15	4	290	<20	25	1.24	1.4
	8/07/62	-	-	370	<20	20	-	1.6
	8/08/62	-	-	300	<20	15	-	1.6
	8/09/62	-	-	280	<20	30	-	1.8
	8/10/62	-	-	160	<20	10	-	1.6
	8/11/62	-	-	190	20	30	-	1.8
	8/13/62	-	-	180	20	25	-	1.8
	8/13/62	-	-	230	<20	20	-	1.1
	8/14/62	-	-	120	<20	260	-	1.6
	8/16/62	-	-	170	<20	<10	-	1.5
	8/17/62	-	-	140	<20	10	-	1.6
	8/17/62	-	-	140	20	30	-	1.4
	8/18/62	-	-	140	<20	20	-	1.7
	8/20/62	-	-	70	10	20	-	1.6
	8/21/62	-	-	70	20	10	-	1.7
	8/27/62	-	-	30	<20	10	-	1.7
Douglas County Nevada	8/04/62	25	9	40	<20	45	1.12	1.7

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Elko Nevada	8/12/62	225	22	70	50	115	1.12	1.4
Ely Nevada	8/02/62	-	-	410	60	135	-	1.6
	8/03/62	-	-	320	50	130	-	1.1
	8/04/62	-	-	260	20	110	-	1.2
	8/05/62	-	-	240	40	105	-	1.1
	8/06/62	-	-	350	20	180	-	1.6
	8/10/62	-	-	270	80	140	-	2.0
	8/11/62	160	8	200	50	130	1.13	1.3
	8/12/62	-	-	220	20	15	-	1.2
	8/13/62	-	-	220	50	130	-	1.7
	8/14/62	-	-	190	30	90	-	1.6
	8/15/62	-	-	230	90	90	-	2.0
	8/16/62	-	-	180	50	125	-	1.4
Fallon Nevada	8/02/62	-	-	30	<20	65	-	1.9
Kamas Utah	8/03/62	-	-	1500	160	18[illegible]	-	1.4
	8/06/62	15	13	1500	170	240	1.78	2.9
	8/09/62	-	-	660	30	110	-	1.4
	8/13/62	-	-	310	40	90	-	1.9
	8/16/62	-	-	210	70	100	-	1.9

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Kamas								
Utah (cont')	8/20/62	-	-	170	30	90	-	2.1
Logan								
Utah	8/01/62	-	-	130	<20	100	-	1.6
	8/02/62	-	-	60	20	120	-	1.5
	8/03/62	-	-	70	30	115	-	1.5
	8/04/62	-	-	70	<20	155	-	1.5
	8/06/62	-	-	30	20	110	-	1.6
	8/07/62	-	-	50	20	95	-	1.6
	8/08/62	-	-	30	<20	150	-	1.6
	8/09/62	-	-	40	<20	75	-	1.5
	8/14/62	-	-	50	<20	115	-	1.5
	8/15/62	-	-	40	<20	130	-	1.4
	8/20/62	-	-	30	<20	75	-	1.6
	8/27/62	-	-	<20	<20	90	-	1.9
	8/31/62	-	-	20	<20	75	-	1.6
Lund								
Nevada	8/10/62	75	5	400	<20	100	1.04	1.6
	8/13/62	-	-	60	20	65	-	1.7
	8/16/62	-	-	280	40	90	-	1.5
	8/20/62	-	-	60	<20	70	-	1.6
	8/27/62	-	-	50	<20	50	-	1.8

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Oakley Utah	8/03/62	-	-	1200	270	145	-	1.6
	8/06/62	530	35	980	170	130	1.24	1.7
	8/09/62	-	-	170	<20	80	-	1.6
	8/13/62	-	-	430	100	130	-	1.0
	8/16/62	-	-	220	80	100	-	1.6
	8/20/62	-	-	90	30	60	-	1.3
Ogden Utah	8/01/62	-	-	200	20	120	-	1.7
	8/02/62	-	-	260	20	80	-	1.7
	8/03/62	-	-	180	30	100	-	1.7
	8/04/62	-	-	240	20	70	-	1.9
	8/05/62	-	-	180	20	85	-	1.8
	8/06/62	-	-	210	10	80	-	1.7
	8/07/62	-	-	140	20	100	-	1.7
	8/08/62	-	-	150	20	60	-	1.9
	8/09/62	-	-	600	<20	10	-	1.4
	8/10/62	-	-	120	<20	60	-	1.5
	8/12/62	-	-	120	20	50	-	1.8
	8/15/62	55	8	100	<20	70	1.12	1.7
	8/16/62	-	-	70	<20	50	-	1.7
	8/17/62	-	-	110	<20	70	-	1.8
	8/19/62	-	-	70	<20	70	-	1.9
	8/21/62	-	-	60	<20	75	-	1.5

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Ogden Utah (cont')	8/27/62	-	-	30	20	55	-	1.8
Panaca Nevada	8/01/62	-	-	130	20	40	-	1.7
	8/02/62	-	-	230	< 20	55	-	1.7
	8/03/62	-	-	210	20	30	-	1.3
	8/05/62	-	-	220	< 20	30	-	1.5
	8/06/62	10	2	370	20	30	1.08	2.3
	8/07/62	-	-	270	40	< 10	-	1.7
	8/08/62	-	-	220	30	30	-	2.1
	8/09/62	-	-	50	180	10	-	1.3
	8/10/62	-	-	110	20	20	-	1.6
	8/11/62	-	-	110	< 20	40	-	1.5
	8/12/62	-	-	80	< 20	40	-	1.5
	8/13/62	-	-	120	< 20	35	-	1.8
	8/14/62	-	-	130	< 20	30	-	1.6
	8/17/62	-	-	90	< 20	15	-	1.9
	8/18/62	-	-	80	< 20	30	-	1.8
	8/19/62	-	-	100	20	10	-	1.8
	8/20/62	-	-	40	40	80	-	1.9
	8/20/62	-	-	20	< 20	40	-	1.4
	8/21/62	-	-	30	< 20	30	-	1.8
	8/25/62	-	-	30	< 20	< 10	-	1.4
	8/27/62	-	-	20	20	20	-	1.5

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Pioche Nevada	8/01/62	-	-	50	<20	30	-	1.6
	8/02/62	-	-	470	20	40	-	1.4
	8/03/62	-	-	670	10	45	-	1.9
	8/04/62	20	6	830	<20	45	1.08	1.5
	8/05/62	-	-	820	20	50	-	1.5
	8/06/62	-	-	720	<20	50	-	1.6
	8/07/62	-	-	890	<20	60	-	1.6
	8/08/62	-	-	1000	40	25	-	1.7
	8/09/62	-	-	720	250	10	-	1.0
	8/10/62	-	-	610	200	30	-	1.5
	8/11/62	-	-	230	30	55	-	2.0
	8/12/62	-	-	490	40	50	-	1.5
	8/13/62	-	-	570	30	40	-	1.9
	8/14/62	-	-	670	<20	50	-	1.5
	8/16/62	-	-	300	100	40	-	1.7
	8/17/62	-	-	420	20	35	-	1.8
	8/18/62	-	-	230	<20	50	-	1.7
	8/19/62	-	-	280	<20	50	-	1.9
	8/20/62	-	-	300	<20	40	-	1.5
	8/21/62	-	-	190	<20	50	-	1.5
	8/27/62	-	-	120	30	35	-	1.7
Snyderville Utah	8/02/62	-	-	40	<20	80	-	1.9

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Snyderville								
Utah(cont')	8/03/62	145	12	420	60	90	1.06	1.7
	8/03/62	-	-	740	130	170	-	1.7
	8/06/62	-	-	570	90	170	-	1.7
	8/06/62	-	-	250	20	95	-	1.7
	8/09/62	-	-	880	<20	150	-	1.9
	8/09/62	-	-	380	50	120	-	1.7
	8/13/62	-	-	130	20	90	-	1.7
	8/13/62	-	-	320	30	80	-	1.6
	8/16/62	-	-	170	30	80	-	1.5
	8/16/62	-	-	110	50	<10	-	1.8
	8/20/62	-	-	110	30	75	-	1.5
Wells								
Nevada	8/12/62	90	12	20	<20	105	1.14	2.0
White River Valley								
Nevada	8/20/62	100	10	50	30	50	1.11	1.8
	8/27/62	-	-	30	20	60	-	2.0
Vernal								
Utah	8/21/62	-	-	180	20	35	-	1.4
	8/21/62	-	-	150	<20	80	-	1.6
	8/21/62	-	-	490	40	40	-	1.6
	8/21/62	-	-	30	20	30	-	1.7
	8/21/62	-	-	570	40	80	-	1.2

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Vernal Utah(cont')	8/21/62	-	-	210	10	70	-	1.5
Yerrington Nevada	8/06/62	-	-	<20	<20	115	-	1.5
	September 1962							
Alamo Nevada	9/07/62	10	3	40	20	15	1.08	1.8
Blue Eagle Ranch Nevada	9/06/62	140	7	90	40	70	1.04	1.9
	9/12/62	-	-	130	30	155	-	1.6
Caliente Nevada	9/06/62	10	< 10	60	<20	10	1.10	1.7
Logan Utah	9/04/62	-	-	70	20	70	-	1.8
	9/06/62	40	17	60	20	90	1.06	1.7
Lund Nevada	9/07/62	30	5	20	<20	45	1.00	1.7
	9/11/62	-	-	<20	30	55	-	1.5
Ogden Utah	9/03/62	-	-	30	<20	50	-	1.6

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Panaca Nevada	9/07/62	-	-	<20	<20	30	-	1.9
	9/07/62	15	2	20	<20	40	1.01	1.7
	9/12/62	-	-	<20	10	10	-	1.5
	9/14/62	-	-	<20	<20	10	-	1.5
Springdale, Nevada	9/07/62	10	2	30	<20	15	1.34	1.4
St. George Utah	9/17/62	-	-	20	20	20	-	1.6
White River Valley Nevada	9/07/62	110	10	60	50	70	1.18	1.8
	9/13/62	-	-	60	30	60	-	1.5
	October 1962							
St. George Utah	10/01/62	10	3	20	<10	30	1.27	1.6
	10/15/62	30	4	20	<10	20	1.25	1.7
Blue Eagle Ranch Nevada	10/15/62	125	13	80	20	140	1.47	1.7
Barstow California	10/23/62	45	4	130	30	30	1.36	1.3
Pahrump Nevada	10/23/62	35	4	40	140	20	1.33	1.3

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Springdale Nevada	10/23/62	25	6	160	20	70	1.45	1.2
	10/30/62	35	3	140	<10	60	1.41	1.1
Bakersfield California	10/24/62	< 5	4	10	<10	<10	1.34	1.5
Richfield Utah	10/24/62	-	-	40	<10	45	-	1.6
M.K. Stewart Dairy Alamo	November 1962							
Nevada	11/20/62	85	< 2	<10	<10	20	1.34	1.8
Ash Meadows Nevada	11/06/62	5	< 2	<10	<10	<10	1.40	1.4
Pahrump Nevada	11/02/62	-	-	<10	<10	<10	-	1.1
Bakersfield California	11/01/62	-	-	<10	<10	<10	-	1.6
Barstow California	11/02/62	-	-	110	30	30	-	1.4
	11/12/62	35	3	20	30	15	1.41	1.4

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Brawley California	11/01/62	-	-	<10	<10	<10	-	1.5
Riverside California	11/01/62	-	-	<10	<10	20	-	1.6
Victorville California	11/01/62	-	-	<10	<10	<10	-	1.6
St. George Utah	11/12/62	35	8	<10	<10	45	1.07	1.5
Eunice New Mexico	11/02/62	<5	7	340	40	60	1.30	1.3
St. George Utah	December 1962	10	5	30	<10	40	1.21	1.7
Fristoe Dairy Eunice New Mexico	January 1963 1/28/63	15	5	<10	<10	45	1.33	1.2
Alamo Nevada	1/17/63	<5	3	30	<10	60	1.28	2.1

Appendix A-Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Blue Eagle Ranch Nevada	1/11/63	75	21	<10	20	285	1.50	1.2
	1/16/63	35	34	20	20	215	1.65	1.0
Caliente Nevada	1/30/63	<10	4	<10	<10	60	0.93	1.5
Ely Nevada	1/10/63	30	9	<10	<10	165	1.24	1.8
Eureka Nevada	1/10/63	60	6	<10	<10	85	1.62	1.4
Lund Nevada	1/10/63	<10	<10	<10	<10	55	1.25	1.7
Moapa Nevada	1/31/63	5	5	<10	<10	30	1.16	1.5
Pahrump Nevada	1/14/63	95	8	<10	<10	85	1.29	1.5
Pioche Nevada	1/15/63	5	< 2	<10	<10	30	1.53	1.4
Springdale Nevada	1/15/63	15	4	20	30	45	1.31	1.6

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Anderson Dairy Las Vegas, Nevada	1/14/63	10	6	<10	<10	35	1.27	1.8
Arden Dairy Las Vegas, Nevada	1/14/63	25	3	<10	<10	25	1.22	1.5
Bliss Dairy Las Vegas, Nevada	1/14/63	15	3	20	<10	30	1.23	1.4
Clark Dairy Las Vegas, Nevada	1/14/63	25	5	20	<10	40	1.17	1.5
Hinie's Dairy Las Vegas, Nevada	1/14/63	15	5	<10	<10	55	1.27	1.5
Meadow Gold Dairy Las Vegas, Nevada	1/14/63	< 10	7	<10	30	75	1.24	1.7
Newcastle Utah	1/31/63	35	8	35	20	65	1.03	1.6
St. George Utah	1/31/63	15	8	<10	<10	25	1.29	1.3
	1/16/63	5	< 5	<10	20	35	0.91	1.1
	1/31/63	5	3	<10	<10	30	-	1.1
Blue Eagle Ranch Nevada	February 1963 2/05/63	50	27	<10	<10	285	1.54	1.2

Appendix A-Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Ely Nevada	2/05/63	30	9	<10	<10	165	1.24	1.8
Lida Nevada	2/06/63	10	4	<10	<10	55	1.19	1.5
Lund Nevada	2/06/63	15	10	<10	<10	65	1.36	1.6
Springdale Nevada	2/13/63	20	6	<10	40	50	0.94	1.7
Anderson Dairy Las Vegas, Nevada	2/14/63	5	4	<10	30	55	1.24	1.7
Bliss Dairy Las Vegas, Nevada	2/14/63	5	5	<10	<10	65	1.19	1.7
Clark Dairy Las Vegas, Nevada	2/14/63	< 5	5	<10	<10	45	1.18	1.7
Hiland Dairy Las Vegas, Nevada	2/14/63	< 5	8	<10	<10	65	1.16	1.5
Hinie's Dairy Las Vegas, Nevada	2/14/63	1[illegible]	2	<10	40	45	1.23	1.6
Meadow Gold Dairy Las Vegas, Nevada	2/14/63	< 5	7	10	30	75	1.24	1.7

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Newcastle Utah	2/20/63	-	-	<10	<10	<10	-	1.7
St. George Utah	2/20/63	< 5	15	70	25	25	1.18	1.4
Alamo Nevada	March 1963							
	3/28/63	15	3	<10	<10	55	1.11	1.8
Blue Eagle Ranch Nevada	3/07/63	15	14	30	20	280	-	1.5
Caliente Nevada	3/28/63	10	5	<10	<10	40	1.14	1.4
Ely Nevada	3/06/63	10	5	40	20	50	-	1.2
Hiko Nevada	3/29/63	5	3	<10	<10	20	1.20	1.6
Lund Nevada	3/06/63	5	8	<10	<10	80	1.21	1.6
Moapa Nevada	3/29/63	10	4	<10	<10	45	1.16	1.5
Nyala Nevada	3/28/63	15	5	30	20	85	1.32	1.4
Pahrump Nevada	3/14/63	35	5	<10	<10	85	1.33	1.6

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Pioche Nevada	3/27/63	10	3	<10	<10	20	1.23	1.7
Springdale Nevada	3/14/63	25	< 2	<10	<10	25	1.08	1.0
Anderson Dairy Las Vegas, Nevada	3/15/63	5	5	<10	<10	40	1.18	1.5
Arden Dairy Las Vegas, Nevada	3/15/63	5	4	<10	<10	35	1.08	1.6
Bliss Dairy Las Vegas, Nevada	3/15/63	5	7	<10	<10	50	1.14	1.6
Hiland Dairy Las Vegas, Nevada	3/15/63	5	5	<10	<10	55	1.12	1.6
Hinie's Dairy Las Vegas, Nevada	3/15/63	< 5	6	<10	<10	40	1.09	1.7
Meadow Gold Dairy Las Vegas, Nevada	3/15/63	5	9	<10	<10	65	1.16	1.3
Garrison Utah	3/05/63	7	15	<10	<10	65	0.92	1.6
St. George Utah	3/26/63	-	-	<10	<10	15	-	1.0
Newcastle Utah	3/28/63	-	-	<10	<10	20	-	1.7

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
	April 1963							
Adaven Nevada	4/22/63	10	6	<10	<10	40	1.34	1.5
Alamo Nevada	4/24/63	< 5	6	<10	<10	20	1.20	1.8
Blue Eagle Ranch Nevada	4/10/63	50	22	20	<10	265	1.66	1.4
Caliente Nevada	4/24/63	85	12	<10	<10	60	0.99	1.7
Duckwater Nevada	4/08/63	10	5	<10	<10	95	1.18	1.4
Ely Nevada	4/05/63	10	3	<10	<10	45	1.23	1.5
Fish Creek Ranch Nevada	4/05/63	30	5	<10	20	170	1.26	1.2
Hiko Nevada	4/24/63	10	5	<10	<10	30	1.24	1.7
Lund Nevada	4/08/63	5	8	<10	<10	80	1.21	1.6
Moapa Nevada	4/25/63	35	7	<10	<10	55	0.85	1.8
Pioche Nevada	4/24/63	-	-	<10	<10	30	-	1.8
Springdale, Nevada	4/30/63	50	7	<10	<10	140	0.94	1.4

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Twin Springs Ranch Nevada	4/29/63	10	8	<10	<10	35	-	1.6
Anderson Dairy Las Vegas, Nevada	4/17/63	10	6	<10	<10	45	1.12	1.6
Arden Dairy Las Vegas, Nevada	4/17/63	35	7	<10	<10	50	1.11	1.5
Bliss Dairy Las Vegas, Nevada	4/17/63	10	7	<10	<10	45	1.15	1.7
Hiland Dairy Las Vegas, Nevada	4/17/63	15	5	<10	<10	40	1.10	1.6
Hinie's Dairy Las Vegas, Nevada	4/17/63	45	9	10	<10	40	1.12	1.7
Meadow Gold Dairy Las Vegas, Nevada	4/17/63	< 5	12	<10	<10	70	1.18	1.6
Newcastle Utah	4/23/63	< 5	5	<10	<10	20	1.28	1.6
St. George Utah	4/24/63	20	7	<10	<10	50	1.25	1.8
	May-1963							
Anderson Dairy Las Vegas, Nevada	5/13/63	25	13	<10	<10	35	1.28	1.6
Arden Dairy Las Vegas, Nevada	5/13/63	40	8	<10	<10	50	1.10	1.4
Bliss Dairy Las Vegas, Nevada	5/13/63	10	18	<10	<10	45	1.10	1.6

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
		Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Hiland Dairy Las Vegas, Nevada	5/13/63	30	12	<10	<10	60	1.19	1.6
Hinie's Dairy Las Vegas, Nevada	5/13/63	40	10	<10	<10	45	1.18	1.6
Meadow Gold Dairy Las Vegas, Nevada	5/13/63	< 5	16	<10	<10	70	1.15	1.6
Elgin Nevada	5/01/63	495	80	<10	<10	120	1.43	1.5
Fish Creek Nevada	5/15/63	30	15	<10	<10	175	1.36	1.4
Lida Junction Nevada	5/07/63	25	7	<10	<10	60	1.32	1.6
Lund Nevada	5/15/63	< 5	5	<10	<10	45	1.14	1.6
Pahrump Nevada	5/03/63	10	7	<10	<10	75	0.93	1.6
St. George Utah	5/28/63	20	6	<10	<10	55	1.08	1.7
Newcastle Utah	5/29/63	< 5	8	<10	<10	20	1.06	1.5
Loving New Mexico	5/22/63	5	9	<10	<10	30	1.19	1.6
Eunice New Mexico	5/22/63	110	21	<10	<10	75	1.12	1.5

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Adaven Nevada	5/31/63	45	23	<10	<10	70	1.45	1.3
Nyala Nevada	5/31/63	20	5	<10	<10	70	1.38	1.2
Pahrump Nevada	5/27/63	20	9	<10	<10	60	1.10	1.4
Springdale Nevada	5/29/63	75	10	<10	<10	85	1.31	1.4
RO Ranch Nevada	5/31/63	145	28	<10	<10	120	1.18	1.6
	June 1963							
Caliente Nevada	6/26/63	45	12	<10	<10	90	1.10	1.6
Fallon Nevada	6/01/63	< 5	12	<10	<10	<10	1.40	1.7
	6/02/63	5	< 2	-	-	-	1.13	-
Hawthorne Nevada	6/02/63	5	5	<10	<10	55	1.00	1.6
Anderson Dairy Las Vegas, Nevada	6/10/63	30	5	<10	30	80	1.09	1.9
Arden Dairy Las Vegas, Nevada	6/10/63	20	7	<10	<10	45	1.10	1.7
Bliss Dairy Las Vegas, Nevada	6/10/63	20	7	<10	<10	65	1.17	1.7

Appendix A - Results of Milk Sample Analyses, Operation Storax (cont')

COLLECTION DATA		RADIOCHEMICAL DATA						
		ACTIVITY (pc/l)					CONCENTRATION(gm/l)	
LOCATION (Azimuth and Distance from CP-1)	DATE COLLECTED	Sr^{89}	Sr^{90}	I^{131}	Ba^{140}	Cs^{137}	Ca	K
Hiland Dairy Las Vegas, Nevada	6/10/63	30	8	< 10	< 10	65	1.12	1.6
Hinie's Dairy Las Vegas, Nevada	6/10/63	15	6	< 10	30	55	1.09	1.8
Meadow Gold Dairy Las Vegas, Nevada	6/10/63	40	11	< 10	30	80	1.10	1.8
Newcastle Utah	6/26/63	75	26	< 10	< 10	115	1.12	1.4
Pahrump Nevada	6/18/63	30	6	< 10	< 10	50	1.27	1.4
Springdale Nevada	6/19/63	30	9	< 10	30	80	1.05	1.7